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TROPICAL DISEASES RESEARCH FUND.

REPORT

OF THE

ADVISORY COMMITTEE

FOR THE

TROPICAL DISEASES RESEARCH FUND, FOR THE YEAR 1906.

Presented to both Houses of Parliament by Command of His Majesty.
January, 1907.



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TROPICAL DISEASES RESEARCH FUND.

REPORT

OF THE

ADVISORY COMMITTEE FOR THE TROPICAL DISEASES RESEARCH FUND,

FOR THE YEAR 1906.

The Advisory Committee for the Tropical Diseases Research Fund was constituted by the Secretary of State for the Colonies in July, 1904, and is composed as follows:—

The Right Honourable Sir J. West Ridgeway, G.C.B., G.C.M.G., K.C.S.I.,
P.C. (Chairman).
Sir T. Barlow, Bart., M.D., K.C.V.O.
Sir M. Foster, K.C.B., F.R.S.
Sir P. Manson, M.D., K.C.M.G., F.R.S.
Sir R. Moor, K.C.M.G.
Surgeon-General A. M. Branfoot, C.I.E.
Mr. T. W. Holderness, C.S.I.
Mr. C. P. Lucas, C.B.
Mr. H. J. Read.

The Revenue of the Tropical Diseases Research Fund for the year 1906 was £3,000, made up as follows:—

	£
Contribution from the Imperial Government	500
Contribution from the Government of India	500
Contribution from the funds at the disposal of the Rhodes Trustees	200
Contributions from Colonial Governments	1,800

in the following proportions:—

Commonwealth of Australia	200
Gold Coast	200
{ Southern Nigeria	200
{ Lagos	150
Ceylon	100
Straits Settlements	100
Federated Malay States	100

	£
Hong Kong	100
Trinidad	100
Mauritius	100
Fiji	100
Sierra Leone	100
Gambia	100
British Guiana	100
Grenada	50

The expenditure of the year consisted of grants as follows:—

Grant to the Liverpool School of Tropical Medicine ...	500
Grant to the London School of Tropical Medicine...	1,000
Grant to the University of London	750
Grant to the Royal Society	500

making in all a total of £2,750, and leaving a balance of £250.

The grant to the Liverpool School was employed by the School for the payment of the salaries of a Lecturer in economic entomology and parasitology, and of a Lecturer in tropical medicine. Both these Lecturers are required to devote their spare time to research.

The grant to the London School was devoted to the payment of the salaries of a combined teacher and investigator of protozoology and a combined teacher and investigator of helminthology, and to the provision of suitable apparatus, &c.

By means of the grant to the University of London there has been established a Professorship of Protozoology, to which post has been appointed Mr. E. A. Minchin, M.A., late Jodrell Professor of Zoology at University College, London, and some time Fellow of Merton College, Oxford, who was recently employed in Uganda in connexion with the investigation of sleeping sickness.

The contribution to the Royal Society was employed on the research into sleeping sickness.

The Advisory Committee, in allocating the funds placed at their disposal, have desired to secure the establishment on a secure basis of the study of tropical diseases. The ends they have endeavoured to attain are, on the one hand, the provision of instruction in regard to tropical diseases for medical officers employed in the Colonies and Protectorates, and, on the other hand, the furtherance of research work and investigation as to the nature and causes of such diseases.

The first end has in great measure been attained by the provision of lectureships in entomology and parasitology, in helminthology and protozoology, at the Liverpool and London Schools of Tropical Medicine. All medical officers appointed to posts in the Crown Colonies or Protectorates are in ordinary circumstances required, before proceeding to the Colony or Protectorate, to undergo a course of three months' training at one of the Schools of Tropical Medicine. Representations have recently been made by the Lecturer on Tropical Medicine in the Liverpool School that that period is insufficient for a thorough grounding in the essential elements of tropical medicine, and it has been suggested that a course of six months should be substituted. The Committee, while recognizing the advantages of a longer course, consider that the extra cost involved and the delay entailed in insisting upon attendance at a six months' course in the case of medical officers on first appointment would be serious, and they suggest that, if any step is taken, it should be on the lines of enabling those medical officers who are considered by the Colonial Government under which they serve to show exceptional promise, to attend a more advanced course of instruction on the first occasion of their being on leave of absence in England.

The Committee have also had under their consideration the important question of facilitating research work in tropical diseases in the Colonies themselves. A Circular despatch* on this question was addressed by the Secretary of State to the Governors of the Crown Colonies and Protectorates on the 23rd of April, 1906, and the Memorandum which is appended† summarizes the replies received up to date, which are also printed in the Appendix.‡ The Committee have advised the Secretary

* Appendix I.

† Appendix II.

‡ Appendix III.

of State that it is desirable that whenever possible well-equipped laboratories should be provided in the Colonies in charge of specially-trained officers. The Committee have also asked for half-yearly reports on the scientific work done at the laboratories already established at Singapore, Colombo, Kuala Lumpur, Port of Spain, Hong Kong, Demerara, and Mauritius.

The Committee note with satisfaction that the appointment of a Professor of Protozoology at the University of London has been followed by the creation of a similar post at the University of Cambridge. The duties of the Professorship at the University of London are intended in the main to be research work in protozoology, but it is hoped that it will be found possible for the Professor to deliver a certain number of lectures in the course of the year dealing with his work and the progress made in the study of the subject. The Committee feel that it is most important that this professorship should be adequately endowed, and that its continuance should be secured.

The Committee have also had under their consideration a proposal to establish a post for investigation and instruction in pathological entomology in connexion with the University of London, and at the same time with the London School of Tropical Medicine. They recognize that such an appointment would not only be of great value in human tropical medicine, but would also give valuable assistance to the prosecution of the study of veterinary science in so far as it concerns tropical countries. They have under consideration the question whether funds can be found for this purpose.

The Committee append to their report the reports* of the lecturers at the Liverpool and London Schools of Tropical Medicine for the year November, 1905, to October, 1906, and a report of the Royal Society for the year 1905, in which will be found details of the work done and of the papers published in connexion with the subjects for which the grants were made. It is satisfactory to note that, despite the claims on their time in other directions, the Lecturers at the Schools of Tropical Medicine have been able to conduct researches of importance and value, not only from the scientific point of view, but also from the point of view of the immediate amelioration of conditions of life in tropical countries by the suggestion of prophylactic measures against disease.

Special importance in this regard attaches to the work of Mr. R. L. Leiper, Lecturer in Helminthology at the London Tropical School on the etiology and prophylaxis of Dracontiasis, a disease which is widely disseminated through the native races of the British Colonies and Protectorates in tropical Africa, as well as in India and some other tropical countries. This disease during the last five years has twice broken out in epidemic form among the West African Frontier Force, attacking the European officers as well as natives, and is a fruitful source of difficulties in the labour supply. Hitherto prophylactic measures have been seriously hampered by ignorance of the life history of the parasite *Dracunculus medinensis*, which causes the disease, and especially of the manner in which it gains access to the human body. Mr. Leiper went to West Africa in August, 1905, to investigate on the spot these and other points in connection with the disease. The result of his observations and experiments has been, in the opinion of the Committee, to show conclusively that direct infection of man, whether by the skin or by the mouth, is impossible. Mr. Leiper's researches confirm those of Fedschenko and Manson, who showed many years ago that the embryo, after escaping from the human body, develops into the mature larva after entering the body cavity of a small fresh-water crustacean of the genus cyclops, the metamorphosis being completed about the fifth week. Mr. Leiper finds that the larvæ never leave the cyclops spontaneously in ordinary conditions, but if a cyclops containing larval guineaworms at this stage of development be transferred to a 0.2 per cent. solution of hydrochloric acid death immediately results to the cyclops while the larvæ are awakened to great activity and escape from the body of the dead cyclops. This experiment of Leiper's clearly points to man being infected by the mouth. When a cyclops containing guineaworm larvæ at an advanced stage of development is swallowed, the action of the gastric juice produces precisely the same effect on cyclops and guineaworm larvæ as that of the weak solution of hydrochloric acid in the experiment. This conclusion has received

* Appendix IV. Liverpool. Appendix V. London. Appendix VI. Royal Society.

remarkable confirmation from the experiment of feeding a monkey on bananas containing infected cyclops, a post-mortem examination revealing the presence of half-grown filariæ possessing the features characteristic of *Dracunculus medinensis*.

These facts suggest a prophylaxis based on the need of the parasite: (1st) for immediate contact with water, (2nd) entry into a cyclops, and (3rd) the swallowing of that cyclops by man.

Mr. Leiper suggests that care should be taken to prevent the use for drinking purposes of waters in which bathing is done, or which might be contaminated by the discharges from the limbs of individuals suffering from guineaworm. Such precautions are observed in some places on the Gold Coast, and it would probably not be impossible to adopt a similar practice more generally. Ponds might be enclosed by fences and draw wells dug at a short distance from the ponds from which natives could obtain their water supplies, and this with less trouble than is involved in wading, as at present, into the ponds and in collecting the fouled water in calabashes.

Mr. Wenyon has been engaged at the Pasteur Institute and at Munich University on interesting investigations on *Trypanosoma dimorphon* and on a new species of Spirochaete, which he has discovered in mice.

Dr. Stephens and Mr. Newstead, of the Liverpool School, have conducted interesting and important researches in entomology and parasitology: the latter has in preparation a report on the injurious insects of the West Coast of Africa.

Special attention may be called to the investigations of Dr. Thomas and Mr. Breinl, of the Liverpool School, in connection with sleeping sickness, published in Volume XVI. of the Memoirs of the School, and especially to the results of their experiments on the treatment of trypanosomiasis (pp. 49-63), for the purposes of which experiments a contribution was made by the Committee in 1905. The investigators conclude that the most promising direction in which a cure of trypanosomiasis can be looked for is in the use of a combination of arsenic and of an improved form of trypanred, and they urge that further efforts should be made to produce less toxic compounds of arsenic suitable for hypodermic injection. In the meantime, the School have despatched to medical officers in the Congo and other parts of East Africa over 2,000 grammes of atoxyl. This is being used on cases of trypanosomiasis under the direction of the School, and reports will be furnished in due course on the results obtained.

Of the investigations conducted by the Royal Society, special interest attaches to the researches made by Professor Minchin, during his visit to Uganda, into the relation of tsetse fly to the trypanosome of sleeping sickness and the exact role played by this fly in the transmission and propagation of the disease. The Committee of the Royal Society are also carrying on investigations as to remedial drugs.

WEST RIDGEWAY,
Chairman.
A. BERRIEDALE KEITH,
Secretary.

December 22, 1906.

APPENDIX I.

THE EARL OF ELGIN to THE GOVERNORS.*

(Circular.)

SIR, Downing Street, April 23, 1906.

IN his circular despatch of the 28th of May, 1903,† Mr. Chamberlain summarised the steps which had been taken up to that date in combating the diseases of the tropics; and he noted that the two main lines of advance had been scientific enquiry into the causes of those diseases, especially of malaria, and the better training of medical officers in the methods of treatment and prevention.

2. In either direction steady progress has been made. The Schools of Tropical Medicine at London and Liverpool have been gradually strengthened and placed on a sound basis by improvement of their equipment, extension of their accommodation and additions to their teaching staff. The period for which Colonial Medical Officers are required to undergo instruction in tropical medicine in this country has been extended; test examinations have been imposed; and diplomas in tropical medicine have been instituted at the University of Cambridge and elsewhere. The arrangements for training medical men, destined for tropical service, in what may be described as their routine duties, no doubt can and will be still further improved; but there is every reason to be satisfied that a future supply of medical officers well versed in the special studies which tropical conditions and tropical diseases demand, is assured for the British Possessions.

3. Scientific research, too, has been stimulated, and the field of knowledge widened by the efforts of enquirers and expeditions sent out in connection with the Royal Society or with the tropical schools; and the formation of a Tropical Diseases Research Fund, to which the Imperial Government, the Colonies and India have alike contributed, bears witness to a continuing interest in the work of investigation. What appears to me to be still wanting is to link the side of scientific research more closely to that of medical training, and this forms the subject of the present despatch.

4. The training which Colonial Medical Officers at present receive in this country is an essential preliminary to independent research; but seeing that the course of instruction at present only lasts for three months, it cannot be more than an introduction to research work. When the officers thus trained have gone out to the tropics, their time must and should be mainly occupied by their ordinary professional duties. Further, they are far removed from the centres of modern scientific enquiry; and, not being directly encouraged to undertake original research, they cannot be expected to give to it the attention and the experience which it demands. It is therefore no matter for surprise that the medical services of the tropical Crown Colonies and Protectorates, in most cases sparingly manned, do not, under existing conditions, lend themselves to original research. Hence difficulty has been, and is being, experienced in obtaining from this source men qualified, as competent investigators, to hold bacteriological appointments, or to take part in special Commissions of Enquiry.

5. It is true that a step forward has already been taken by the establishment of a Research Institute at Kuala Lumpur, in the Federated Malay States, and by the creation of appointments for purposes of research in some other Colonies, such as the bacteriological posts to which I have referred, and which have been created in Hong Kong, the Straits Settlements, Ceylon, Mauritius and British Guiana. The total number of these appointments, however, which does not exceed seven or eight, is insignificant when compared with the work to be done, and, although the appointments are few and comparatively well paid, much difficulty has under present conditions been experienced in filling them.

* Sent to the Governors of the West Indian Colonies, to Bermuda, Fiji, the Eastern Colonies, and to the Mediterranean Colonies, the West African Colonies, and the West African and East African Protectorates.

† [Cd. 1598] June, 1903.

6. Accordingly, after consulting my expert advisers, I suggest that, when a Colony or Protectorate has an adequate medical staff and is in a position to devote funds to scientific purposes without unduly stinting its other requirements, a sum might be voted, either annually or at longer intervals, for the express purpose of detailing one or more of its Medical Officers to study the latest phases of modern scientific research at the best known centres; and possibly, after a few months spent in this way, to carry out further researches in the Colony before reverting to ordinary professional work. Each Colony has its own special conditions which distinguish it from other Colonies; and its own conditions must vary from time to time, so that those who are on the spot at a given time must be best able to decide what money can be afforded and how it can be best expended to secure the object in view. I simply recommend that over and above the work of the bacteriologist of the Colony, if there is one, some member of the practising medical staff shall year by year, or at stated intervals, be deputed to bring back to the Colony and directly into the medical work of the Colony the latest results of the most highly organised scientific research.

7. I need not say that it would be necessary to take due precautions :—

- (1) That a medical officer, after his special course, is not diverted to some other Colony; the obvious safeguard for which is that he should undertake to refund the money which has been expended upon him, in the event of his leaving the Government service or accepting a transfer to another Colony within a certain time from the date of his mission; and
- (2) That due care is taken in the selection of one out of a number of medical officers for a privilege which, if it involves hard study, will presumably be without expense for the student (for I would suggest that full pay and free passages should be granted) and will involve a residence for a portion of the time at any rate in a healthier climate than the tropics. Missions of the kind contemplated will also clearly be a great boon, not only as affording leisure for scientific research, but also as qualifying the officer who takes proper advantage of them for higher positions in the future. From all points of view, therefore, they should be given to picked men who have not merely shown aptitude for research but have been conspicuously efficient and energetic in the discharge of their immediate professional duties.

I have, &c.,
ELGIN.

The Officer Administering
the Government of

APPENDIX II.

MEMORANDUM ON THE TRAINING OF COLONIAL MEDICAL OFFICERS IN SCIENTIFIC RESEARCH WORK.

1. The question of combating the diseases of the Tropics was summarised by Mr. Chamberlain in his circular despatch of the 28th of May, 1903.* He noted that the main lines of advance had been, first, scientific enquiry into the causes of those diseases, especially of malaria, and secondly, the better training of medical officers in the methods of treatment and prevention.

2. In his circular despatch of the 23rd of April, 1906, Lord Elgin pointed out that steady progress had been made in both these directions. The Schools of Tropical Medicine at London and Liverpool had been strengthened and improved,

* [Cd. 1598], June, 1903.

and their teaching staff had been increased; the period for which Colonial medical officers are required to undergo instruction in tropical medicine in this country had been extended, test examinations imposed, and diplomas in tropical medicine instituted at Cambridge and elsewhere.

3. Lord Elgin noted that there was still room for improvement in the arrangements for training medical men destined for tropical service as regards their routine duties, though he apprehended that there would be no difficulty in obtaining an adequate supply for the British possessions of medical officers well versed in the special studies which tropical conditions and tropical diseases demand.

4. As regards scientific research, the field of knowledge has been widened by the efforts of enquirers and expeditions sent out in connection with the Royal Society or with the Tropical Schools, and a Tropical Diseases Research Fund has been created, to which the Imperial Government, the Colonies, and India have all contributed.

5. The point upon which Lord Elgin laid stress was the desirability of linking scientific research more closely to that of medical training. He pointed out that the training which Colonial medical officers receive in this country is an essential preliminary to independent research, but as the period of instruction at present does not exceed three months, it can only be regarded as an introduction to research work. Officers so trained are, however, mainly occupied by ordinary professional duties in the tropics. They are far removed from the centres of modern scientific enquiry, to which they cannot be expected to give the attention and the experience which it demands as they are not directly encouraged to undertake original research. Under the circumstances, therefore, the Medical Services of the tropical Crown Colonies and Protectorates, which, in most cases, are sparingly manned, do not lend themselves to original research. In consequence of this, the difficulty has been to obtain men qualified as competent investigators to hold bacteriological appointments, or to take part in special Commissions of Enquiry.

6. A step forward has been taken by the establishment of a research institute at Kuala Lumpur, in the Federated Malay States, and by the creation of appointments for purposes of research in some other Colonies, for instance, Hong Kong, the Straits Settlements, Ceylon, Mauritius, and British Guiana. The total number of these appointments does not exceed seven or eight, and is insignificant when compared with the work to be done, and although the appointments are few, and comparatively well paid, great difficulty has, under present conditions, been experienced in filling them.

7. After full consideration, therefore, Lord Elgin suggested that when a Colony or Protectorate has an adequate medical staff, and is in a position to devote funds to scientific purposes without unduly stinting its other requirements, a sum might be voted either annually or at longer intervals for the express purpose of detailing one or more of its medical officers to study the last phases of modern scientific research at the best known centres, and, after a few months had been spent in this way, to carry out further research in the Colony before reverting to ordinary professional work.

8. Lord Elgin pointed out that inasmuch as each Colony had its own special conditions which distinguished it from other Colonies, and that these conditions must vary from time to time, those who were actually on the spot should be best able to decide what money could be afforded, and how it could best be expended to secure the object in view. He further recommended that over and above the work of the bacteriologist of the Colony, if there was one, some member of the practising medical staff should, year by year, or at stated intervals, be deputed to bring back to the Colony, and directly into the medical work of the Colony, the latest results of the most highly organised scientific research.

9. Lord Elgin pointed out that it would be necessary to take due precautions:—

- (1) That a medical officer after his special course should not be diverted to some other Colony; and
- (2) That due care should be taken in the selection of one out of a number of medical officers for a privilege which would presumably be without

expense to the student (for he suggested that full pay and free passages should be granted), and involve a residence, for a portion of the time at any rate, in a healthier climate than the tropics; and he also added that missions of this kind should only be given to picked men who had shown not merely aptitude for research, but also conspicuous efficiency and energy in the discharge of their ordinary professional duties, inasmuch as such a mission would, in addition to leisure for scientific research, also afford qualifications for higher positions in the future for the officer who took proper advantage of them.

10. This circular was sent to the Governors of the following Colonies:—

West Indies, Bermuda, Fiji, and to the Eastern Colonies, and to the Mediterranean, West, and East African, Colonies.

11. Replies have so far been received from eleven Colonies and Protectorates. Of these, seven Colonies are unable to adopt the Secretary of State's proposal, either owing to the lack of the necessary funds or to the numerical insufficiency of the medical staff, or both of these reasons. These Colonies are:—

Sierra Leone, Seychelles, Leeward Islands (three), Fiji, and Northern Nigeria.

In the case of Barbados, the proposals cannot be adopted as there is no Government medical service.

The Commissioner of Uganda stated that he would act on the Secretary of State's suggestion when a suitable medical officer was available.

In the case of the Gold Coast the sum of £100 will be inserted in the next estimates for the purpose of sending home a medical officer selected to undergo special training.

In that of British Guiana, the Governor stated that the Combined Court would be asked next session (February, 1907), to vote the funds necessary for carrying out Lord Elgin's suggestions.

12. The Governor of Hong Kong pointed out, in his reply to the circular despatch, that the Colony, in addition to capital expenditure incurred in the erection and fitting up of a bacteriological institute, devoted a large sum annually to scientific purposes. According to the estimates for the current year, the expenditure on the Institute in question, including the salaries of two bacteriologists, amounts to about £1,820, to which is being added £230 in connexion with the Cancer Research Fund, and the investigation of tropical diseases, and to the London School of Tropical Medicine, or a total of £2,050. He stated that he would hesitate to recommend any considerable increase of this expenditure for scientific research, especially in view of the fact that it was not possible to devote funds to the full extent desirable for such works as past research has shown to be necessary. In this connexion the Governor referred particularly to "Draining of Nullahs" as a preventive to malarial, and to "Resumption of insanitary properties" as a preventive to plague.

13. Sir M. Nathan added that for this reason, and also for the further reason that an increase of the medical staff of the Colony would be necessary if officers other than those on half-pay leave were detailed from time to time to study the latest phases of modern scientific research in the best known centres, he did not see his way to adopt the recommendation put forward in the circular despatch from the Secretary of State, except in so far as that officers undergoing special tuition in England during their ordinary half-pay leave might, on their return to Hong Kong, have the fees paid for such tuition returned to them on the recommendation in each case of the Medical Adviser to the Colonial Office. Sir M. Nathan further pointed out that the medical officers of the Colony generally devoted the greater part of their leave to study and research, and that they had been granted extensions of leave for those purposes.

14. The Acting High Commissioner of Northern Nigeria laid stress in his reply on the great value of such scientific enquiry as that indicated by the Secretary of State, and suggested the advisability of obtaining a special grant from the Treasury for this work. He pointed out, however, that an addition to the existing

medical staff would be required and also the erection and equipment of a bacteriological laboratory. The importance of the latter was insisted on by the Acting Principal Medical Officer in a minute enclosed in the Acting High Commissioner's despatch, in view of the fact that the difficulties in the way of ordinary microscopical examination were very great, owing to the local climatic conditions, even at the two cantonments of Zungeru and Lokoja, where the facilities for such work were greater than at other stations.

15. In the case of Fiji, the Chief Medical Officer suggested that since the existing medical staff was barely sufficient for its duties, it might be preferable for the purpose indicated by Lord Elgin to select a worker already possessed of the required training, and to appoint him for service in the Colony on research work for a specified term of, say, three years. He mentioned that the principal diseases prevailing in Fiji, namely, yaws, leprosy, and filariasis, were not ordinarily familiar to medical men practising in temperate and civilised countries, and that the determination of the agency or agencies by which leprosy especially is propagated, was a question of the very highest importance. Filariasis did not seem to affect the Indian population of the Colony, and only rarely the Europeans, a circumstance which, in addition to its limitation and prevention, deserved further study. In the Chief Medical Officer's opinion, better work would be done by, say, three competent and able investigators selected in England, and appointed for periods of two or three years to each of the tropical Crown Colonies in rotation, as he believed that prolonged residence in the tropics in one place did not favour energetic work or profound study, and in so far as Fiji was concerned, he considered that the Colony would derive a maximum of benefit at a minimum of cost by participating in such a scheme, and bearing its proportion of the expense.

16. The Governor of the Leeward Islands, on the contrary, suggested that every Crown Colony, the finances of which were in a solvent condition, should be compelled to set aside annually so much of its revenue as would enable the Government to make provision for every Government medical officer to take six months' leave of absence every three years on full salary, on the condition that at least three months out of the six were spent either at a Tropical School of Medicine, or with the approval of the Secretary of State, in studying some of the most recent phases of modern scientific research. He pointed out in support of this suggestion that, if it had been put into practice during the last six years, there would not have been that lamentable ignorance which was displayed last year in Belize by medical practitioners during the outbreak of yellow fever, which cost the lives of so many Europeans.

17. The Acting Governor of Southern Nigeria suggested a definite scheme for the establishment of a medical research institute at Lagos, at an annual cost for maintenance of, in the first instance, £1,500, to which he proposed that the West African Colonies should contribute in the following proportions:—

Southern Nigeria	...	...	...	...	£600
Gold Coast	...	...	...	...	400
Northern Nigeria	...	...	...	...	200
Sierra Leone	...	...	...	...	200
The Gambia	...	...	...	...	100
Total					£1,500

18. He stated that although the climates in the West African Colonies, and even in different portions of the same Colony, varied a great deal, yet the diseases prevalent were common to the whole of West Africa, and that, therefore, a research institute established in one Colony would be for the benefit of all. He considered that Lagos was the most suitable site for such an institute, owing to its facilities for communication, and the density of the surrounding population. He estimated the cost of the necessary buildings, including quarters for two European Officers, at £2,000, of which Southern Nigeria would contribute £1,000, and the Gold Coast £500, the remainder being defrayed by Northern Nigeria, Sierra Leone, and the Gambia in equal proportions of £166 apiece. He put the salary of the Head of the Institute at £800 when on duty, and £400 while on leave, his assistant being given £500 while on duty and £250 during leave. The cost of passages, instruments, and incidental

expenses would probably bring the total annual cost to £1,500. A separate account would be kept of all expenditure and receipts, and any surplus funds could be employed in enlarging the Institute, or perfecting its equipment; in the event of a deficiency the various Administrations concerned would be called upon to make it good in proportion to their original contributions.

19. The Principal Medical Officer of Southern Nigeria, who strongly supported the scheme, desired that it might be impressed upon the Colonial Office authorities that the establishment of a research laboratory on a small scale might be expected to result in practical good, and possible economy, owing to the manufacture of fresh calf lymph. And further, that it should be clearly understood that no medical officer of the Southern Nigeria staff was fit for such work, and that an expert was essential. He pointed out that the present medical staff was numerically inadequate for the ordinary work of the Protectorate, and that he could not, therefore, consider the question of the appointment of one of the staff to the post of a research worker.

20. Secondly, Dr. Strachan expressed the opinion that the courses of instruction, however beneficial in themselves, could not fit anyone to speak with authority on such a question as those involving any research in the bacteriology and parasitology of tropical or other diseases, and that if medical science was to gain solid benefit, it would be far better that a specially trained officer, who had devoted his time and energies to such special pursuits as were involved, should be appointed as the research officer in the Protectorate. The experience of allowing medical officers to undergo courses of instruction had been tried, and all possible facilities had been given them to carry on local research work as far as their ordinary duties permitted, but the result had been disappointing, as it was apparent that no really useful work in parasitology or bacteriology could be done by any medical officer on the staff in connection with the ordinary duties of his appointment. Dr. Strachan added that years of training were necessary for any real value to be attached by the medical and scientific world to the opinions of workers in such subjects. For these reasons, therefore, Dr. Strachan advocated the appointment of a skilled and specially trained biologist, not necessarily a medical man, but if he were, one who is not engaged in the practice of his profession, who should devote his whole time to biological work, parasitology, and bacteriology of animals and plants, and should have a small farm where calf vaccine-lymph could be prepared and supplied to the Colonies.

Colonial Office,

November 22, 1906.

APPENDIX III.

(1.)

UGANDA.

COMMISSIONER HESKETH BELL to THE EARL OF ELGIN.

(Received June 29, 1906.)

MY LORD,

Government House, Entebbe, Uganda, June 1, 1906.

I HAVE the honour to acknowledge the receipt of your circular, of 23rd April last, relative to scientific enquiry into tropical diseases.

2. Your Lordship's suggestions will be borne in mind, and as soon as it becomes evident that a suitable officer is available in this Protectorate for the special studies referred to, efforts will be made to utilise him accordingly.

I have, &c.,

H. HESKETH BELL,

His Majesty's Commissioner.

(2.)

BARBADOS.

GOVERNOR SIR G. T. CARTER to THE EARL OF ELGIN.

(Received July 2, 1906.)

MY LORD,

Government House, June 7, 1906.

I HAVE the honour to acknowledge the receipt of Your Lordship's circular despatch of the 23rd of April last, in which it is suggested that provision should be made by the several Colonies in which there is an adequate medical staff, for detailing one or more Medical Officers to study the latest phases of modern scientific research at the best known centres.

2. I have considered this suggestion in Executive Committee, but, in view of the fact that there is no Government Medical Service here, and of other local conditions, the Committee does not see its way to adopt the proposal.

I have, &c.,

G. T. CARTER,

Governor.

(3.)

SOUTHERN NIGERIA.

ACTING GOVERNOR FOSBERY to THE EARL OF ELGIN.

(Received July 6, 1906.)

MY LORD,

Government House, Lagos, June 13, 1906.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of the 23rd of April last, on the subject of scientific enquiry into the causes of tropical diseases, the establishment of a local research institute, and the detailing of one or more of our medical officers to study the latest phases of modern scientific research at the best known centres. I now enclose copy of a minute on the subject by the Principal Medical Officer to whom Your Lordship's circular was referred.

2. Although the climates in the different British Administrations in West Africa, and even in different portions of the same administration, vary a good deal, yet the diseases prevalent are common to the whole of West Africa, therefore, if an efficient research institute were established in one, the enquiries pursued would be of use to all, and, there can be little doubt, the diseases can be better studied where numerous subjects suffering from them are available than in countries where the diseases are exotic, and where recovery may not be due so much to treatment as to the change of climate enabling the patient to throw off the disease or to the climate being in itself fatal to the development of the malady.

3. The establishment of a proper institute, and the employment of skilled enquirers therein must involve a considerable expenditure which probably no single administration in West Africa would be capable or willing to contribute.

4. Lagos is by far the largest town on the West African Coast. It has a railway running through thickly populated country, containing larger centres of population than exist in any other British West African Administration. The length of this railway will very shortly exceed 200 miles, and will probably be largely extended in the near future. The port of Lagos is also within easy and frequent communication with nine ports of Southern Nigeria at which ocean steamers call, and with a nearly equal number of ports on the Gold Coast. Lagos town, therefore, seems to be the most suitable position for such an institute. I suggest, therefore, for Your Lordship's consideration, the advisability of establishing such a medical

research institute at Lagos, the cost of maintenance being restricted in the first instance to an annual expenditure of £1,500 contributed as follows:—

Southern Nigeria	...	...	...	...	£600
Gold Coast	...	...	...	...	400
Northern Nigeria	...	...	...	...	200
Sierra Leone	...	...	...	...	200
Gambia	...	...	...	...	100
					£1,500

5. I estimate that the cost of the necessary building, including quarters for the two Europeans, would be £2,000, of which:—

Southern Nigeria should contribute one-half (£1,000),

Gold Coast should contribute one-quarter (£500),

Northern Nigeria, Sierra Leone, and Gambia should contribute one-twelfth each (£166).

Lagos would provide the site.

6. I propose for the head of the institute a salary of £800 when on duty, and half that salary when on leave, his assistant being given £500 when on duty and half salary when on leave. Passages, instruments, and incidental expenses would probably bring up the total annual cost to £1,500.

7. A separate account would be kept of all expenditure and receipts, and any surplus funds could be employed in enlarging the institute or perfecting its equipment, and the participating administrations would be called upon to make good any deficiency in proportion to their original contributions.

8. The following is a proposal of the Principal Medical Officer, Dr. H. Strachan:—

“I would only suggest that if it be impressed on Colonial Office authorities that *practical* good—and possible economy—by manufacture of fresh calf lymph—may be expected from a research laboratory and small farm—it may prove an extra inducement. Farther, they should understand clearly, that no medical officer of our staff is fitted for such work, and an expert is essential.”

I have, &c.,

W. FOSBERY,

For Sir WALTER EGERTON,

Acting Governor.

Enclosure.

MINUTE BY THE PRINCIPAL MEDICAL OFFICER.

1. That I should most cordially welcome the establishment here of means whereby reliable and useful research work in tropical diseases might be carried out, is shown by the fact that I have, for some time past, advocated the appointment of a trained biologist; and I have reason to think that His Excellency the Governor has given his favourable consideration to my suggestions on the subject. Hence I most cordially support the suggestion contained in His Excellency's minute and in the despatch of the Secretary of State. Southern Nigeria, by its position and supply of material, would be well suited as the site of a biological laboratory and farm, where researches in the bacteriology and parasitology of man and other animals, and of the plants of the country, could be adequately and usefully carried out by specially trained and reliable observers.

2. After long observation, and careful consideration, I had, last year, concluded that such research work cannot be carried out in a way satisfactory to science, or to the advance of tropical medicines to any very marked extent, by medical officers of the Department engaged in the active discharge of the duties devolving on them; and I note that paragraph 4 of the despatch of the Secretary of State shows that this fact has been recognized and accepted by His Lordship. I have no hesitation in saying that we cannot, and must not, expect the contrary, and ought not, longer, to depend on the efforts of our medical officers, no matter how well meant.

In the first place, as I have proved elsewhere, our staff is not, numerically, adequate to our daily demands, and we are always hard pressed to provide medical officers for the various posts needing to be filled. It is clear that from that cause alone it is unnecessary for me to discuss the question of the appointment of one of the medical staff to the post of a research worker.

In the second place, I am satisfied that short courses of instruction, however beneficial from one point of view, cannot fit any one to speak with authority on such questions as are involved in research in the bacteriology and parasitology of tropical or, indeed, other diseases; and that if medical science is to gain solid benefit it were better far that some one, specially trained, and who has devoted his time and energies to such special pursuits as are involved, should be established as our research officer. We have tried the experiment of allowing medical officers to take courses of instruction, and have afforded them all possible facilities permitted by the exigencies of their duty to carry on research work here, but the result has been disappointing for the reasons given.

3. I will quote from my last Annual Report that portion in which I dealt with my suggestions on the subject, and in which, I think, I have given the substance of what I wrote in my letter of 19th September, 1905, and in that of 26th February, 1906.

Parasitological Work.

"I am quite satisfied that any real, useful, work in parasitology or bacteriology cannot be done by any medical officer on the staff in connection with the other duties that necessarily devolve on him. Farther, special training, indeed, years of training, are necessary for any real value to be attached by the medical and scientific world to the dicta of workers in such special subjects. It is not possible for a medical officer here to discharge his ordinary duty, and also do the research work we desire in those subjects.

* * * * *

"I have (during the past year) strongly advised the Government that it will be most advantageous to the Colony if a skilled, specially trained, biologist be appointed—not necessarily a medical man, but if he be so, one not engaged in the practice of that profession. He should devote his whole time to biological work, parasitology and bacteriology of animals and plants, and should have a small farm whence calf vaccine-lymph can be prepared by him and supplied to the Colony. Such an officer will fill a gap in our scientific staff which needs filling urgently. It is quite impossible for any member of the medical staff, no matter how willing he may be to help, to do the sort of work that is profitable and valuable to science and to the Colony. This is quite clear from our attempts during the past three years. Four at least of our medical officers have attended special courses in bacteriology and parasitology, and have done some little work here. But it is not possible for any one, however willing and talented, to acquire the knowledge which commands respect for his opinions, in such specialised branches of research, except by devoting first, years to their study, and afterwards, his whole time and energies to his observations and experiments. Hence it is that I have urged the special appointment of a trained biologist, if such work is to be profitably done in Lagos in the future."

4. I cannot but think that a suitable man could be found willing to undertake the kind of work that would benefit science ultimately, while at the same time benefiting this Colony in a practical way in the immediate present. If his salary were

contributed to by each West African Government, it would be of sufficient amount to secure the services of a skilled authority, while not putting any strain on the resources of any one Government.

H. STRACHAN,
Principal Medical Officer.

May 18, 1906.

(4.)

GOLD COAST.

ACTING GOVERNOR BRYAN to THE EARL OF ELGIN.

(Received July 6, 1906.)

MY LORD,

Government House, Accra, June 14, 1906.

I HAVE the honour to acknowledge the receipt of Your Lordship's circular despatch of the 23rd of April, in which my attention is drawn to the desirability of linking to the ordinary medical training the advance which has been and is being made in scientific research with respect to tropical diseases.

2. I have referred the question to the Principal Medical Officer, who entirely concurs with the views expressed by Your Lordship, but thinks that it will be difficult to find capable men; he also points out that expenditure will be incurred by the proposal that a medical officer should be detailed to attend for some months at one of the Tropical Schools of Medicine.

3. With due deference to the Principal Medical Officer's opinion, I believe that the medical staff of this Colony contains a proportion of capable men who are keenly interested in the progress of modern scientific research, and who would eagerly avail themselves of an opportunity of acquiring knowledge which would fit them to undertake original investigations.

I propose, therefore, subject to Your Lordship's approval, to insert a sum of £100 (which the Principal Medical Officer considers should be sufficient) in the estimates for next year for the purpose of sending a specially selected medical officer, on the conditions mentioned in paragraph 7 of the despatch under reply, to study the latest progress in scientific enquiry at the School of Tropical Medicine in London.

I have, &c.,
H. BRYAN,
Acting Governor.

(5.)

HONG KONG.

GOVERNOR SIR M. NATHAN to THE EARL OF ELGIN.

(Received July 13, 1906.)

MY LORD,

Government House, Hong Kong, June 9, 1906.

I HAVE the honour to acknowledge the receipt of Your Lordship's circular despatch of the 23rd April, 1906, on the subject of linking scientific research more closely to the training of medical officers in the methods of treating and preventing the diseases of the tropics.

2. As Your Lordship is aware, Hong Kong, in addition to capital expenditure incurred in the erection and fitting up of a Bacteriological Institute, devotes a

large sum annually to scientific purposes. According to the estimates for the current year the expenditure on the Bacteriological Institute, including the salaries of two bacteriologists, amounts to about £1,820 to which has to be added £230 in grants to the Cancer Research Fund, to the fund for investigation of tropical diseases, and to the London School of Tropical Medicine. I should greatly hesitate to recommend any considerable increase to this expenditure for scientific research, especially in view of the fact that it is not possible to provide funds to the full extent desirable for such works as past research has shown to be necessary. In this connection I refer particularly to "Draining of Nullahs" as a preventive to malaria and to "Resumption of Insanitary Properties" as a preventive to plague.

3. For this reason and for the further one that the medical staff of the Colony would have to be increased if officers other than those on half-pay leave were detailed from time to time to study the latest phases of modern scientific research at the best known centres, I do not see my way to adopting the recommendation contained in the sixth paragraph of the despatch under reply, except in so far that officers undergoing special tuition in England during their ordinary half-pay leave might on their return to the Colony have the fees paid for such tuition returned to them on the recommendation in each case of the Medical Adviser to the Colonial Office.

4. I am informed that the officers of the Medical Department of Hong Kong generally devote the greater part of their leave to study and research. This has been recognised by the grant of extensions of leave to them for the purposes of study. The further concession now proposed will prevent medical officers being deterred, on account of not being able to afford the fees involved, from taking out special courses of study while on leave.

I have, &c.,
M. NATHAN,
Governor, &c.

(6.)

SEYCHELLES.

GOVERNOR DAVIDSON to THE EARL OF ELGIN.

(Received July 28, 1906.)

MY LORD, Government House, Seychelles, June 18, 1906.

I HAVE the honour to acknowledge the receipt of Your Lordship's circular despatch of the 23rd April, on the subject of the special training, in tropical diseases, of Colonial medical officers.

2. The present condition of the finances of this Colony does not admit of an officer being detailed to study the progress of modern scientific research at a European centre; but the importance to the welfare of tropical colonies of the principle of affording a selected officer special opportunity for being kept abreast of modern medical research being fully recognised, any chance occasion which may arise will be taken to give medical officers when on leave special facilities for study.

I have, &c.,
W. E. DAVIDSON,
Governor.

(7.)

LEEWARD ISLANDS (ANTIGUA).

GOVERNOR SIR E. B. SWEET-ESCOTT to THE EARL OF ELGIN.

(Received July 30, 1906.)

MY LORD, Government House, Antigua, July 3, 1906.

WITH reference to paragraph 6 of Your Lordship's circular despatch of the

23rd April last, in which it is suggested "that, when a Colony or Protectorate has an adequate medical staff and is in a position to devote funds to scientific purposes without unduly stinting its other requirements, a sum might be voted, either annually, or at longer intervals, for the express purpose of detailing one or more of its medical officers to study the latest phases of modern scientific research at the best-known centres," I have the honour to forward the enclosed extract from the Minutes of proceedings of the Antigua Executive Council at a meeting held on the 13th instant.

2. The Council viewed with much favour Your Lordship's suggestion, but it was felt that until Antigua has regained a position of financial independence it would be impossible to recommend the adoption of a course which, if approved, would increase the annual indebtedness of this Presidency to the Imperial Government.

3. The first aim of this Government must be to reduce the expenditure of Antigua and to increase, if possible, its revenue. When the time arrives that the revenue of the Presidency exceeds its expenditure, then, I should suggest that, after setting aside annually a part of its surplus revenue for building up a reserve fund, the balance should be apportioned in the first instance, for the improvement of sanitation and education in Antigua and for the very desirable objects referred to in Your Lordship's circular despatch.

I have, &c.,
BICKHAM SWEET-ESCOTT,
Governor.

Enclosure.

The Governor laid before the Council the Secretary of State's circular despatch of the 23rd April, 1906, which had been previously circulated among the members of the Council, suggesting that, when funds were available, medical officers should be detailed to study the latest phases of modern scientific research at the Schools of Tropical Medicine at London or Liverpool.

The Council advised that the suggestions contained in the Secretary of State's circular despatch should be acted on, so far as Antigua was concerned, whenever funds were available for the special purpose in view.

(8.)

LEEWARD ISLANDS (DOMINICA).

GOVERNOR SIR E. B. SWEET-ESCOTT to THE EARL OF ELGIN.

(Received August 30, 1906.)

MY LORD,

Government House, Antigua, August 2, 1906.

WITH reference to my despatch of the 3rd ultimo,* I beg to forward the following despatch from the Administrator of Dominica.

I have, &c.,
BICKHAM SWEET-ESCOTT,
Governor.

Enclosure.

SIR, Government House, Dominica, July 26, 1906.
 I HAVE the honour to acknowledge the receipt of Your Excellency's despatch, of the 3rd instant, and to inform you that I have taken no action on the Secretary of State's Circular despatch of the 23rd April last, as it appeared to me to be a matter touching the Colony as a whole, and not one, in the absence of a sufficiently large and properly constituted Government Medical Service, that could be dealt with by me.

2. As desired by Your Excellency, I have laid the despatch of the Secretary of State, together with your despatch, before the Executive Council, and the Council advise that they do not see the way to effect being given to carry out the suggestion made in paragraph 6 of Lord Elgin's despatch, so far as this Colony is concerned.

I have, &c.,
 DOUGLAS YOUNG,
 Administrator.

His Excellency
 Sir Bickham Sweet-Escott, K.C.M.G.,
 &c., &c., &c.

(9.)

LEEWARD ISLANDS (ST. KITTS-NEVIS).

GOVERNOR SIR E. B. SWEET-ESCOTT to THE EARL OF ELGIN.

(Received August 30, 1906.)

MY LORD, Government House, Antigua, August 9, 1906.
 WITH reference to the despatches* noted in the margin, I have the honour to forward copy of a despatch from the Acting Administrator of St. Kitts-Nevis, stating that the Executive Council, in view of the small staff of medical officers in the Presidency, are of opinion that it is not possible to take advantage of the benefits to be derived from the adoption of the course suggested in paragraph 6 of Your Lordship's Circular despatch of the 23rd April last.

2. I venture to record my opinion, based on the experience gained during the last twenty-five years of medical practitioners in tropical Colonies, that every Crown Colony, the finances of which are in a solvent condition, should be compelled, in the interests of the inhabitants, to set aside annually so much of its revenue as will enable the Government to make provision for every Government Medical Officer taking six months' leave of absence every three years, and for paying such officers full salary during the leave, on the condition that at least three months out of the six are spent either at a Tropical School of Medicine, or, with the approval of the Secretary of State, in studying some of the most recent phases of modern scientific research. If this regulation had been in force during the last six years, it is to be expected that there would not have been that lamentable ignorance which was displayed last year in Belize by medical practitioners during the outbreak of yellow fever, resulting in so many deaths among Europeans, owing, first of all, to the inability of medical officers to detect cases of yellow fever, and then to their want of knowledge in the treatment of the disease.

* Nos. (7) and (8).

3. It is to me a real cause for regret that, owing to the insolvency of Antigua, I cannot suggest, in the case of this Presidency, the adoption of the regulation to which I have referred in the preceding paragraph.

I have, &c.,

BICKHAM SWEET-ESCOTT,

Governor.

Enclosure.

SIR,

Government House, St. Kitts, West Indies, July 30, 1906.

WITH reference to Your Excellency's despatch of the 3rd instant, I have the honour to inform Your Excellency that I laid the Secretary of State's Circular despatch of the 23rd April last, before the Executive Council of this Presidency, and the Council, in view of the small staff of medical officers in St. Kitts-Nevis, were of opinion that it was not possible to take advantage of the benefits that would arise if the course suggested in paragraph 6 of Lord Elgin's despatch were adopted.

I have, &c.,

F. S. WIGLEY,

Acting Administrator.

His Excellency the Governor,
Leeward Islands,
Antigua.

(10.)

FIJI.

GOVERNOR SIR E. IM THURN to THE EARL OF ELGIN.

(Received September 15, 1906.)

MY LORD,

Government House, Suva, Fiji, August 8, 1906.

WITH reference to your Circular despatch of 23rd April last, regarding the study by Colonial Medical Officers of modern scientific research, I have the honour to forward a copy of a minute by the Chief Medical Officer on the subject, with which in the main I agree.

2. I am satisfied that the present medical staff of the Colony, costly as it is as compared with the revenue, is barely sufficient to allow of the ordinary leave necessary for health, and is not sufficient to allow a member to be detached for purposes of scientific study elsewhere.

3. As regards Dr. Corney's alternative proposal, while I should feel the greatest sympathy with any attempt to introduce an element of greater scientific interest into the medical work done here, I do not think that any great increase of expenditure on scientific work in this Colony would at present be justifiable.

I have, &c.,

EVERARD IM THURN.

Enclosure.

HONOURABLE COLONIAL SECRETARY,

IT would be difficult to follow these proposals in this Colony. The staff of Medical officers is maintained at a bare working strength for practical duties—a fact which comes in evidence whenever a medical officer applies for leave, or is laid up by illness, or when one withdraws from the Service before his successor arrives.

To further deplete the Department by allotting one member year by year to special study out of the Colony does not, therefore, appear at present practicable, unless the total number be correspondingly increased, at least for a time. That being so, the question would arise, "Would it not be better for the purpose in view to select a worker already possessing the requisite training and fitness and appoint him for service in this Colony on research work for a specified term of, say, three years?"

Of the large number of officers who have served in Fiji in recent years I can only think of two who have possessed the special bent for scientific research which is a *sine qua non* for success in this direction. One of these was Dr. C. W. Daniels, now Superintendent of the (London) Tropical School, and he found it only worth his while to remain here three years—the other was Dr. J. Hannah Murray, who left after fifteen months (at £400 and £410 per annum).

It is also a question whether our Legislative Council, as now constituted, would deem the Colony in a position to devote funds to scientific purposes without unduly stinting its other requirements; but that is a matter which might be tested by proposing a vote.

The principal diseases prevailing in Fiji which are not ordinarily familiar to medical men practising in temperate and civilised countries are yaws, leprosy, and filariasis. The determination of the agency, or agencies, by which leprosy is propagated is a question of the very highest importance, and appears now to be entering on a new and promising phase.

There remains a good deal to be discovered and settled in reference to filariasis and its limitation or prevention. For it is a somewhat curious fact that it does not seem to affect the Indian population: and only rarely the Europeans—a fact which has only been partially explained.

I cannot help being of opinion that better work would be done by three (say) competent and able investigators, specially selected from the mass of material at home for their aptitude in scientific research, who might be appointed for two, or three, year periods to each of the tropical Crown Colonies in rotation, the periods and order of sequence being determined according to needs, and each man working in a different Colony but in regular co-operation with one or both of his fellows (when on similar subjects), as well as in association with the officers of the local medical department of his station for the time being.

Prolonged residence in the tropics in one place does not favour energetic work or profound study: and the changes secured by such a plan as I suggest would, I think, prove very salutary.

I feel, of course, that my function is to advise as regards our own share in the proposals rather than to offer general suggestions alternative to those of the Secretary of State, and in so far as our own Colony is concerned, I think we should derive a maximum of profit at a minimum of cost by participating in some such plan as I have sketched—and, of course, bearing our proportion of the expense.

B. GLANVILL CORNEY.

June 27, 1906.

(11.)

NORTHERN NIGERIA.

ACTING HIGH COMMISSIONER WALLACE to THE EARL OF ELGIN.

(Received September 28, 1906.)

MY LORD,

Government House, Zungeru, September 1, 1906.

I HAVE the honour to acknowledge the receipt of your Circular despatch of the 23rd of April last, and, in reply, to transmit copy of a minute from the Acting Principal Medical Officer.

2. With reference to the questions discussed in paragraph 6 of Your Lordship's despatch, it would hardly be possible for this Protectorate in its present stage to devote any considerable sum so long as the normal expenditure is fixed, without stinting its other requirements, or even with the medical staff available to detail one or more of its medical officers to study scientific research.

3. In view of the enormous value of such scientific enquiry, not only to this Protectorate but to all other tropical Crown Colonies and Protectorates, Your Lordship may be disposed to consider the advisability of approaching the Lords of the Treasury with the object of securing a special grant for this work. In addition to the extra medical staff required it will be necessary to build and equip a bacteriological laboratory, and before taking any further action, I request Your Lordship's instructions in the matter.

I have, &c.,

WM. WALLACE,

Acting High Commissioner.

Enclosure in (11).

MINUTE from Acting Principal Medical Officer, dated August 25, 1906.

SECRETARY,

I REGRET having delayed this very important M.P. I considered it in connection with another on the subject of scientific investigation which necessitated correspondence with distant stations.

There can be no doubt whatever as to the ultimate, and probable enormous, benefit which will accrue from the inauguration of this scheme.

The advantages to be derived from local scientific research are fully recognised here, and the Principal Medical Officer has been in communication with His Excellency the High Commissioner on the subject, but in existing circumstances anything of the kind is obviously impossible.

Even in ordinary microscopical examinations the difficulties are great owing to climatic conditions, and it is not unusual to hear men, fresh from a course at the Tropical School, express keen disappointment at the results they obtain in this branch of the work. I speak of my experience in the two cantonments of Zungeru and Lokoja, where the facilities for the performance of such work are, of course, much greater than at other stations.

I mention this in order to indicate the absolute necessity of having an efficiently equipped laboratory to work in, without which nothing in the shape of research can be done. It will also be necessary to increase the staff.

I have written to the Principal Medical Officer, who is now in England, and I would suggest that a copy of the despatch may be forwarded for his fuller information. He could ascertain the probable cost of erecting and equipping a

bacteriological laboratory such as he would consider needful and feasible, and inform the Secretary of State.

W. H. LANGLEY,
Acting Principal Medical Officer.

August 25, 1906.

(12.)

BRITISH GUIANA.

ACTING GOVERNOR COX to THE EARL OF ELGIN.

(Received October 1, 1906.)

MY LORD, Government House, Georgetown, Demerara, September 13, 1906.

WITH reference to your Lordship's circular despatch of the 23rd April last, suggesting that one of the medical officers of the Colony should be detailed annually to study in England the latest phases of modern scientific research, I have the honour to state that the Combined Court, at its Annual Session in February next, will be asked to vote the necessary funds for the purpose.

I have, &c.,
CHARLES T. COX.

(13.)

LEEWARD ISLANDS (MONTSERRAT).

GOVERNOR SIR E. B. SWEET ESCOTT to THE EARL OF ELGIN.

(Received October 13, 1906.)

MY LORD, Government House, Antigua, September 19, 1906.

IN continuation of my despatch of the 9th ultimo,* I have the honour to forward a copy of a letter from the Commissioner of Montserrat relative to the suggested appropriation of surplus revenue for the purpose of enabling medical officers to study the latest phases of modern scientific research.

I have, &c.,
BICKHAM SWEET-ESCOTT,
Governor.

Enclosure.

SIR, Commissioner's Office, Montserrat, August 30, 1906.

WITH reference to your letter, No. S. S. 156, of the 16th ultimo, I have the honour to forward you the attached extract from the minutes of a meeting of the Montserrat Executive Council held on the 21st instant.

I have, &c.,
W. B. DAVIDSON-HOUSTON,
Lieutenant-Colonel, Commissioner.

The Honourable
The Colonial Secretary of the
Leeward Islands.

* No. (9).

EXTRACT from Minutes of a Meeting of the Executive Council of Montserrat held on the 21st August, 1906.

* * * * *

The Council, whilst realizing the advantages of the proposal, were of the opinion that, in so far as Montserrat was concerned, no funds could be devoted to scientific purposes without unduly stinting other requirements.

* * * * *

APPENDIX IV.

REPORTS RECEIVED FROM THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE.

(1.)

DEPARTMENT OF THE DIRECTOR OF THE TROPICAL RESEARCH LABORATORIES.

SIR, Research Laboratories, Runcorn, July 19, 1906.

As requested I beg to report on the manner in which the special Government Grant-in-Aid for research work into trypanosomiasis has been utilised.

The money was used in assisting the current expenses of the research laboratory, chiefly by the purchase and maintenance of animals for experimental purposes.

The main lines of work prosecuted are mentioned below. The space at my disposal prevents me giving anything more than a mere indication of the researches made. For a comprehensive report, the publications of the school, detailed at the end of this report, should be consulted.

Dr. Thomas and Dr. Breinl, in my absence, were entrusted with the research work at the laboratory. They published the results of the following studies in two communications to the Royal Society and in Memoir XVI. of the Liverpool School of Tropical Medicine:—

I. An attempt to find a remedy for trypanosomiasis; "Atoxyl" was found to be the most efficient drug known at present.

II. Further studies made on the morphology and cultural characteristics, *in vivo* and *in vitro*, of *Trypanosoma gambiense*, *dimorphon*, *evansi*, *brucei*, *equiperdum*, and *equinum*.

III. Clinical and morbid studies of early and advanced cases of human trypanosomiasis.

In April, 1905, Drs. Thomas and Breinl were dispatched by the school to South America to study yellow fever, and Mr. P. A. H. Radcliffe was temporarily given charge of the work, pending the return to England of the late Dr. J. Everett Dutton and the writer (Dr. J. L. Todd), from the expedition on which they were, at that time, serving in the Congo Free State. The school sustained a grievous loss in the death of Dr. Dutton, and, at the beginning of September, I returned alone to Liverpool, bringing with me a large amount of material which was deposited at the Runcorn laboratories for purposes of further investigation. The recently published reports of the Congo Expedition (see list of publications at the end of this letter) were prepared at Runcorn; and studies of the material brought from the Congo have been carried out there on the lines indicated below:—

I. Protracted but unsuccessful attempts to transmit the spirochaete of African tick fever from infected to healthy monkeys by the bites of bed bugs.

II. In November, 1905, Dr. Breinl returned to England, invalided home from South America, where he had had a very severe attack of yellow fever. After

convalescence he joined the work at Runcorn. With Dr. Kinghorn he has carried out extensive studies of "Tick Fever" and "Relapsing Fever." Their work, as yet uncompleted, has considered the morphology of these parasites and their cultural characteristics in animals and various media; the African spirochaete has been shown to be distinct from "*Spirochaeta obermeieri*" (the trypanosome producing "relapsing fever") and it has been named "*Spirochaeta duttoni*." Experiments in immunity have been made with these parasites, with a view of definitely obtaining a therapeutic serum; this work is still progressing. It has been shown that *Spirochaeta duttoni* may pass, *in utero*, from mother to foetus. This fact is exceedingly interesting, when the analogy of this parasite to the *Treponema pallida* of syphilis is remembered. Extensive studies have been carried out to determine the rôle played by the spleen in infection by spirochaetes.

At present attempts are being made to transmit *Spirochaeta obermeieri* from infected to healthy monkeys by the bites of bed bugs; the developmental changes undergone by spirochaetes in infected animals and in *Ornithodoros moubata* are being studied; experiments on immunity to various forms of trypanosomiasis, which have been under observation for the past four years, are still being prosecuted; various trypanosomes, brought back from the Congo, either in stained preparations or living animals, are being identified.

To provide living trypanosomes and spirochaetes for teaching purposes is an additional duty of the Runcorn laboratories.

The following is a list of those who have worked in these laboratories during the past year:—

Dr. H. Wolferstan Thomas, J. H. Todd (Memorial Fellow), Dr. Anton Breinl (Assistant Lecturer, Liverpool School of Tropical Medicine), Mr. P. A. H. Radcliffe, Dr. Allan Kinghorn (Colonial Fellow), Dr. E. L. Pope, Dr. Lewis Williams, Dr. E. N. Tobey (Research Assistants), and Dr. J. L. Todd (Director).

The following is a list of publications issued from the Runcorn Research Laboratories since January, 1905:—

The Experimental Treatment of Trypanosomiasis in Animals, by Dr. H. Wolferstan Thomas, Royal Society Proceedings, Series B, Vol. 76, November 9th, 1905.

Pathological Report of the Histology of Sleeping Sickness and Trypanosomiasis, with a Comparison of the Changes found in Animals infected with *Trypanosoma gambiense* and other Trypanosomata, by Dr. Anton Breinl, Royal Society Proceedings, Vol. 77, Series B, January 30th, 1906.

Trypanosomes, Trypanosomiasis, and Sleeping Sickness, by Dr. H. Wolferstan Thomas and Dr. Anton Breinl, and

Gland Puncture in Human Trypanosomiasis, by the late Dr. J. Everett Dutton and Dr. J. L. Todd, Liverpool School of Tropical Medicine, Memoir XVI., November, 1905.

Observations on the Animal Reactions of the Spirochaete of the African Tick Fever, by Drs. A. Breinl and A. Kinghorn, "Lancet," March 10th, 1906, and Memoir XX., Liverpool School of Tropical Medicine.

On the Specific Nature of the Spirochaete of the African Tick Fever, by Dr. A. Breinl, "Lancet," June 16th, and Memoir XX., Liverpool School of Tropical Medicine.

The Treatment of Human Trypanosomiasis by Atoxyl, by Dr. J. L. Todd, "British Medical Journal," June, 1906.

A means of Checking the Spread of "Sleeping Sickness," by Dr. J. L. Todd, "Lancet," July 7th, 1906.

The following reports of the expedition to the Congo were written at Runcorn:—

The Nature of Human Tick Fever in the Eastern part of the Congo Free State, by the late Dr. J. Everett Dutton and Dr. J. L. Todd, Memoir XVII., Liverpool School of Tropical Medicine.

Gland Palpation in Human Trypanosomiasis and the Distribution and Spread of Sleeping Sickness, by the late Dr. J. Everett Dutton and Dr. J. L. Todd, Memoir XVIII., Liverpool School of Tropical Medicine.
 La Prophylaxie de la Malaria, by the late Dr. J. Everett Dutton and Dr. J. L. Todd, Memoir XX., Liverpool School of Tropical Medicine.

I am, &c.,
 J. L. TODD,
 Director of the Tropical Research
 Laboratories, Runcorn.

The Secretary,
 Liverpool School of Tropical Medicine.

(2.)

DEPARTMENT OF ECONOMIC ENTOMOLOGY AND PARASITOLOGY.

SIR, The University, Liverpool, July 19, 1906.
 The work of this Department of the Liverpool School of Tropical Medicine may be classified under the following heads:—

- (1.) Determination of pathogenic and other arthropoda sent in by medical students and other workers in various parts of the world.
- (2.) Investigations of the life-histories of various pathogenic arthropoda (ticks and mosquitoes).
- (3.) Lectures and demonstrations.
- (4.) Preparation of papers for publication in the memoirs of this school.
- (5.) Museum work.
- (6.) Determination of insects injurious to economic plants, stored grain, &c.

Briefly summarised, the work of this Department under each of these has been as follows:—

(1.) *Determination of Pathogenic and other Arthropoda, &c.*

Considerable time has been devoted to the naming of specimens for medical men and others, chiefly former students of this school, engaged on research work, who have not the means of referring to either specimens or books. This is indirect work, but it undoubtedly facilitates the researches of those engaged in the work of investigation.

Among the more important institutions may be mentioned the following:—

Public Health Offices, Malta.
 Office of the Malarial Commission, General Hospital, Madras.
 Royal Commission on Tuberculosis.
 Mission Hospital, Blantyre, British Central Africa.

The identification of the extensive collections of biting flies and ticks made by Drs. Dutton and Todd are dealt with under heading "4."

(2.) *Investigations of the Life-histories of Pathogenic Arthropoda.*

During the last six months the life-history notes were made on six species of mosquitoes and two species of exotic ticks.

(3.) *Lectures and Demonstrations.*

A course of 40 lectures on Medical Entomology were given to the students in this school during the present term and also to the students attending the course in Veterinary Medicine. Each lecture was followed by a practical demonstration and examination of the insects, &c., bearing directly upon the subject of the lec-

ture. By this means the students acquired a thorough practical training in this Department and should be able to identify all the more important animals concerned in the transmission of disease in man and the domesticated animals.

(4.) *Preparation of Papers for Publication in the Memoirs of this School.*

The following papers have been published:—

- (a) On a new Dermanyssid Acarid found living in the lungs of monkeys (*Cercopithecus schmitzi*) from the Upper Congo. With one plate.

This acarid was found in conducting an autopsy on an experimental monkey.

- (b) On another new Dermanyssid Acarid parasitic in the lungs of the rhesus monkey (*Macacus rhesus*).

This acarid was found in a series of six adult Indian rhesus monkeys belonging to the Royal Commission on Tuberculosis, which were killed on account of having been in contact with a monkey suffering from spontaneous tuberculosis.

- (c) The anatomy of the proboscis of biting flies (joint with Dr. Stephens). Six plates, 28 figures.

This investigation is included in Memoir XVIII., the subject being a cognate one to that of Trypanosomiasis and tsetse flies.

- (d) Report on the collection of biting flies, ticks, &c., collected by Drs. Dutton and Todd during the Congo Expedition, 1902-1905.

This report will be issued during the present year. It deals very fully with the distribution and habits of a large number of insects, and will also include the descriptions of several new mosquitoes, a new tsetse fly (*Glossina Palpalis*, var. *maculata*), together with maps showing the distribution of the more prevalent species and illustrations of all the newly discovered insects.

(5.) *Museum Work.*

Twelve small cases illustrating the life-history and anatomy of a corresponding number of pathogenic and injurious arthropoda have been prepared and placed in the Departmental Museum. These have been designed with a view to facilitating the work of the students, and are also intended to form part of a complete classified series of the arthropoda.

(6.) *Determination of Insects injurious to Economic Plants, etc.*

A brief report on the work in connection with this Department was published in the "Quarterly Journal of the Institute of Commercial Research in the Tropics," of which copies are submitted herewith. Strictly speaking, a portion of this work is of an international character; but the greater part of the material was from British possessions. A list of the institutions, and also the nature of the collections, are given below:—

Cotton Worm Inspection, Tonkh, Egypt.—Scale insects.

Government Gardens, Delta, Barrage, Egypt.—Various insects affecting cotton and other cultivated plants, ornamental trees and shrubs. The nature and extent of this important collection may be gathered from the "Journal" quoted above.

The Khedival Agricultural Society Laboratories, Cairo, Egypt.—Twenty separate packets of insects (*coccidæ*) on various plants.

Kaiserliche Biologische Anstalt für Land und Forstwirtschaft.—Homopterous insects affecting cocoa, rubber, and other cultivated plants in West Africa.

Zoological Museum, Berlin.—Collection of Homopterous insects affecting various plants in Madagascar. The identification of this collection is only partly completed.

Royal Gardens, Kew.—Greenhouse pests.

Board of Agriculture and Fisheries.—Pine aphid.

Other important insect pests have been received from Java on Cinnamon and pepper; from West Africa, on cotton, &c.; from South America, on rubber (Castilloa); from Australia and New Zealand, on ornamental shrubs and fruit trees; from the Canary Isles, on bananas; (see journal *l. c.* p. 18).

I am, &c.,

ROBERT NEWSTEAD,
Lecturer in Economic Entomology and
Parasitology.

The Secretary,
Liverpool School of Tropical Medicine.

(3.)

DEPARTMENT OF THE WALTER MYERS LECTURER OF THE SCHOOL.

SIR,

I HAVE to report that the instruction given by me in the Johnston Laboratory comprises the following subjects:—

Study of Blood.

Methods of examination.—(1) Fresh films, (2) "vital" staining, (3) staining of dried films, especially by the Romanowsky, Leishman and Giemsa methods. (Application of these stains to the study of protozoal parasites.) Polychromasia and basophilia of red cells, their significance in anæmia and blackwater fever. Use of hæmocytometer. Leucocytes, recognition of different varieties. Methods of performing differential and absolute counts. Turek's leucocyte counter. Hæmoglobinometer. Method of using the Gower, Talqvist, Dare and Fleischl-Miescher hæmoglobinometers. Study of platelets and "blood dust." Isotonic point of red cells, method of determining.

Study of Parasites.

Amœbæ: Fresh in stools and methods of staining and preserving. Distinction between amœba of dysentery and non-pathogenic amœbæ. Study of museum specimens of amœbic and bacillary dysentery.

Flagellate protozoa: (a) Examination of *Trichomonas intestinalis*, *Lamblia intestinalis*, *Bodo lacertæ*, fresh and stained; (b) trypanosomata, especial study of the pathogenic forms, *e.g.*, those of Nagana, Surra, Dourine, Mal de Caderas, Gambian horse trypanosomes and sleeping sickness. All these species are kept alive in experimental animals, and can be studied in the fresh conditions. Mode of cultivating trypanosomes.

Ciliata: *Balantidium coli* in fæces if obtainable, or of the *Nyctothera* and *Opalina* in the gut of frogs.

Spirochaetes: At present two species are available for study, viz., the spirochæte of African tick fever (*S. duttoni*) and that occurring in fowls *S. gallinarum*.

Piroplasmata: Owing to the difficulty and expense of constantly maintaining strains of these parasites, they are at present only studied in stained specimens.

Leishman-Donovan Parasites: These are demonstrated in stained films and paraffin sections of the tissues are cut and stained by the students.

Malaria Parasites: Fresh blood with parasites is examined by the students microscopically under my direction at the Royal Southern Hospital, until every student is perfectly familiar with the parasite, and is incapable of making an erroneous diagnosis.

The Malaria Parasite in the Mosquito: An abundant supply of living mosquitoes is always available for dissection, and the methods of dissecting out the salivary glands, stomach, and other organs of the mosquito are demonstrated and practised by the students themselves. The different stages of the malaria parasite from zygote to sporozoit in the mosquito are demonstrated in preserved specimens. The method of imbedding mosquitoes in paraffin, and section cutting is also practised.

The blood parasites of birds, *Halteridium* and *Proteosoma* are studied in the connection, and the *Hæmogregarines* of mammals, amphibians, and reptiles.

Worms: Owing to the extensive ground covered by this subject a study is made only of the more important ones, viz., those pathogenic to man. The methods of fixing and examining worms are especially considered.

Among the worms studied are:—

Ankylostoma duodenale, structure of the mouth parts and bursa, and the method of cultivating embryos.

Schistosomum hæmatobium, male and female, embryos and eggs in urine and fæces. Cutting of sections of bladder, &c.

Filaria bancrofti, embryos. No adults are at present available for demonstration.

Filaria perstans, adults and embryos in blood.

Filaria loa, adults.

Eggs are examined and mounted of the following worms:—

Ankylostoma duodenale, *Oxyuris vermicularis*, *Strongylus subtilis*, *Ascaris lumbricoides*, *Opisthorchis sinensis*, *Paragonimus westermanni*, *Schistosomum hæmatobium*, and those various tape worms found in man.

In the museum nearly all the pathogenic flukes are available for demonstration purposes, and it is hoped that the lacunæ may soon be filled.

The latter part of the course is devoted to bacteriology. The methods of cultivating, and biological characters of, the following organisms are studied, viz.:—

Plague, cholera, dysentery, malta fever and leprosy (in sections and secretions).

I have to report that without exception, the students who attend the classes are hard-working and desirous of learning all they can in the short time available. It is impossible in the time to traverse the whole subject of tropical parasitology, so that, firstly, one endeavours to make the students familiar with the parasites which are of practical importance in every-day work, and secondly, to instruct in the practical methods of research which are of general application, and which it would be in the power of a trained medical man to apply himself.

Students.

The number of students who have attended the classes this year is as follows:—

From January 14th to March 29th, 1906	...	...	...	8
From May 1st to July 16th, 1906	...	...	...	16
				—
Total	...	...	...	24
				—

Of these, two were of the Royal Army Medical Corps, four of the West African Medical Service, two Colonial Medical Service, two Indian Medical Service, and one Indian Emigration.

Of the 24 who attended the course, 16 entered for the Diploma of Tropical Medicine, and 15 passed.

Research.

During the year I have, in connection with Mr. Newstead, published a paper on the Anatomy of the Proboscis of the Tsetse Fly. I am at present engaged in studying (I.) the anatomy of the proboscis of other biting flies, and (II.) the methods of staining bacterial and other flagella, but these researches are not yet complete.

I am, &c.,

J. W. W. STEPHENS,
Walter Myers Lecturer in Tropical Medicine.

The Secretary,
Liverpool School of Tropical Medicine.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received November 15, 1906.)

B 10, Exchange Buildings, Liverpool, November 14, 1906.

Liverpool School of Tropical Medicine: Government Grant.

SIR,

I HAVE the honour to enclose the interim report of the Liverpool School of Tropical Medicine to October 31st, 1906, with reference to the expenditure of the Government Grant allocated to the school.

The interim report in question consists of short statements made by the Lecturer in Tropical Medicine, the Lecturer in Economic Entomology and Parasitology, and the Professor of Tropical Medicine of the School, with regard to different aspects of the work of the School.

I have, &c.,

A. H. MILNE.

Enclosures.

(1.)

DEPARTMENT OF THE WALTER MYERS LECTURER OF THE SCHOOL.

REPORT by Dr. J. W. W. STEPHENS from April 1st, to October 31st, 1906.

In my previous report I gave an outline of the work done in the practical classes held by me in the laboratory. It will be unnecessary to repeat this, but a syllabus of the School is enclosed,* and on page 15 will be found a brief account of these classes. The kind of work done remains practically unchanged. In my last report I stated that "it is impossible in the time to traverse the whole subject of tropical parasitology." Owing to the very rapid progress of knowledge in this branch of science, and to the fact that many new parasites are still being discovered, the difficulty is a constantly increasing one. At present, accordingly, it is the parasites of practical importance that are chiefly considered, so that students have no difficulty in the diagnosis of such parasites. In my opinion, however, it is necessary also that parasites of merely scientific interest should receive greater attention than is at present possible, as it is impossible to say whether a knowledge of such parasites may not eventually have important practical bearing on the study of tropical medicine. I believe that in the interests of students themselves, and of the study of tropical parasitology and bacteriology, it would be advisable considerably to extend the duration of the course. The duration of the course at present is three

* Not printed.

months, but it would be advisable to extend it to six months. Briefly, the reasons for doing this are:—

- (1.) The present subjects could be studied more thoroughly than they can possibly be in the limited time now available.
- (2.) Subjects at present necessarily neglected would receive adequate attention.
- (3.) The time allotted to bacteriology could with advantage be extended so as to include a practical acquaintance with the methods of preparing vaccines and antitoxines, *e.g.*, for cholera, plague, dysentery.
- (4.) The standard of the examination for the Diploma of Tropical Medicine should also be raised. It has been pointed out by a committee of the Royal College of Surgeons deputed to consider the teaching in the schools of tropical medicine that a three months' course is insufficient for acquiring the knowledge which should justify the giving of a diploma. This is, I think, evident from what has been above stated.

DIPLOMA OF TROPICAL MEDICINE.

The number of candidates who entered for the examination in July was 10. Of these nine passed, and it was especially recorded that Dr. George A. Williamson, of the Cyprus Medical Service, passed with distinction.

ENTRIES FOR THE OCTOBER TERM.

The number of students so far is six. Of these, three belong to the Royal Army Medical Corps Service, and one to the Indian Medical Service.

RESEARCH WORK.

During the summer I published two pieces of work:—

- (1.) Note on the structure of *spirochaeta duttoni* in the "Lancet," August 18th, 1906, and
- (2.) The ankylostomes of Burma and Assam in the Indian "Medical Gazette" for October, 1906.
- (3.) During the summer vacation I collected a large amount of material for a research in conjunction with Mr. Newstead into the anatomy of the proboscis of *Stomoxys calcitrans*. A considerable number of sections have already been prepared, and we hope to complete the piece of work before the end of the year.
- (4.) My researches into the methods of staining bacterial flagella are still in progress, but for lack of time are at present incomplete.
- (5.) I have also in preparation a description of a new linguatulid in the Indian rat snake, the record of *Echinorhynchus moniliformis* from man in the West Indies, and a description of a new human *Nematode* at present unidentified.

MUSEUM SPECIMENS.

In furnishing the museum with material necessary for teaching, I am dependent almost entirely on the generosity of various old students and other medical men in response to a personal letter. Specimens of value and interest have been received from the following:—Dr. S. Bell, Hong Kong; Mr. Newbolt, Dr. Dimond, Dr. Kennan, Accra; Captain Patton, Madras; Dr. A. Bremner, Northern Nigeria; Dr. Arnold, Transvaal; Captain Dee, I.M.S.; Dr. Wolferstan Thomas, Captain Carter, I.M.S.; Dr. Elkington, Tasmania; and Major Williams, I.M.S.

I think it should be possible for the supply of material from Colonial Officers to be put on a satisfactory basis, and that medical officers in the Colonies should be asked to collect such material for the use of our museum. I fear that much valuable material from post mortems in the Colonies is at present simply wasted. Such material, if preserved, would be of the greatest service to our museum, and, in fact, teaching has been handicapped in the past for the lack of suitable specimens.

At present I have to rely entirely on appeals by letter from myself, but if it could be arranged that post mortem material in the Colonies should be forwarded, the museum and the teaching would immensely benefit.

(2.)

DEPARTMENT OF ECONOMIC ENTOMOLOGY AND PARASITOLOGY.

REPORT OF THE LECTURER, MR. R. NEWSTEAD, A.L.S., F.E.S., &c., from April 1st, 1906, to October 31st, 1906.

LECTURES AND DEMONSTRATIONS.

Two lectures and three demonstrations have been given weekly during term time to the students in the Departments of Tropical Medicine and Tropical Veterinary Medicine; and six lectures on economic entomology in the Zoological Department of the University.

PAPERS PUBLISHED OR COMPLETED.

1. *On the life-history and the structural characters of the egg, larva, and pupa of Stomoxys calcitrans.* Illustrated with one plate, containing 11 figures.

(See Journal of Economic Biology, Vol. I., No. 4, pp. 157-166, 1906. Copy of which is enclosed herewith.)

Hitherto the life-history of this blood-sucking insect was practically unknown and the earlier stages had not been described or figured. The work should, therefore, prove of great help to all those who are engaged in the study of the transmission of disease by blood-sucking flies and other arthropoda. As *Stomoxys calcitrans* is stated to be one of the known carriers of "Surra," the subject is a cognate one to that of the trypanosomata of mammals.

2. *On the habits and structural characters of the larva of a "Sand Fly" (Simulium ornatum, Mg.).* With 12 figures. This paper will be published in the Memoirs of this School.

3. *On the early stages of Hematobia irritans.*—This paper will also be embodied in the above-named publication.

4. *Report on the blood-sucking and other arthropoda collected by Drs. Dutton and Todd during their expedition to the Congo.*—This work includes the description of several new species of mosquitoes, a new species of stomoxys, a new tsetse fly (*Glossina maculata*, Newstead), &c. With six plates and a number of illustrations in the text. This report is now going through the press and will, it is hoped, be issued by the end of the year.

PAPERS IN COURSE OF PREPARATION.

1. *On the anatomy of the proboscis of Stomoxys calcitrans* (joint with Dr. J. W. W. Stephens).—This paper is intended to form Part II. of the series "on the anatomy of the proboscis of biting flies." Part I. was published in the Memoirs of this School (Memoir XVIII., pp. 53-75).

2. *Report on the injurious insects of the West Coast of Africa.*—The somewhat extensive collection of insects affecting cotton, cocoa, rubber, maize, &c., to be dealt with in this report have already been identified, and endeavours will be made to complete the MS. early in the new year.

IDENTIFICATION OF EXOTIC BLOOD-SUCKING FLIES AND INSECTS INJURIOUS TO ECONOMIC PLANTS.

Several small collections of blood-sucking insects have been forwarded by former students of this School from various parts of the world. These included a species of tsetse fly (*Glossina tachinoides*, Westwood), from Arabia. This

important capture was made by Captain R. Markham Carter, I.M.S., who acted as Medical Officer to the Angola-Turkish Delimitation Commission in South Arabia, during the years 1902-4. Hitherto the tsetse flies (*Glossina spp.*) have been confined to the African continent, and the occurrence of one of them in Arabia is of great economic importance, as it is possible that the presence of this fly may materially affect the development of that country. Captain Carter's notes on the occurrence of the fly are appended herewith.

"In South Arabia the fly was first found at the foot of Jabal Hashar in Haushabi on the bank of the Tiban River. Here several belts of tamarisk occur and within $\frac{1}{2}$ mile a large marsh in the Dakkhan country exists. A second specimen was caught near Addar Rega, at the junction of Wadi Rafad and Wadi Addar Rega also in Haushabi. Five specimens were also caught near the volcanic hot springs of Hawemi adjoining the Adi Nativ. The fly occurred here in cactus belts being locally distributed; in fact none were seen at Am Hathews hot springs about $1\frac{1}{4}$ miles away. It occurred freely at Kurrash on the right bank of the Wadi Nativ, a halting place on the great caravan track to Havia and Tais, $1\frac{1}{2}$ miles below Hawemi. Here are found volcanic springs of cold water arising from tumuli of red and grey mica-laden clay. Flies were not seen near the water's edge but in the adjoining belts of Euphorbia.

"In Subaihi three specimens were caught during the demolition of the forts by the escort of the Commission, in the Al Hay Gorge, they were also several times seen along the banks of the Ghail Akashi and Ghail Maula. Tsetse flies were sparsely seen between Nakil Maoraga and Sanawi in North Subaibi. Here the flies occurred in belts of tamarisk and babal thorn, never in the date groves or along patches of cultivation.

"These flies, occurring as they did scantily amongst myriads of other flies, were very difficult to catch, whilst the hostility of the Arabs in Subaibi precluded any attempts to pass far beyond the limits of our camping positions.

"The Arabian *Glossina tachinoides* does not depend for its existence on big game, for, excepting gazelle, nothing else frequents the belts of bush which it haunts. Only once was the fly recognised by Arabs, and then by a band of wild Bedouins from North-Western Subaibi, who sought medical advice at camp Wadi Kaluli. They stated this fly used to be more frequent in Subaibi, that it bit goats, donkeys, horses, dogs, and men, but did not attack camels or sheep. They further stated that it sucked blood only after the spring rains, that some years it disappeared from a district entirely, that rarely it became abundant, and then they moved their settlement and cattle by night marches to a fly free district. They further had noted a marked diminution in the game in Subaibi, but were uncertain whether it was not more likely due to the introduction of Winchester rifles from Jibutil, than to cattle murrain."

It is worthy of note that horse sickness has again appeared at Kataba in the Amiri country, a Turkish town, situated in the Dthalla Valley, $1\frac{1}{2}$ miles from Jabil Hashar where the fly was first found.

P. 530, Journal of the Royal Army Medical Corps, Vol. 7, No. 5, November, 1906.

PREPARATION OF MATERIAL FOR DEMONSTRATIVE PURPOSES.

A large amount of material illustrating the metamorphoses of *Stomoxys calcitrans*; *Simulium sp.*, *Lyperosia irritans*, and *Hippobosca equina*; have been collected and prepared for the use of the students attending the course of instruction in tropical medicine.

As far as possible living examples of the above-named insects have also been available to the students.

GENERAL WORK OF THE SCHOOL.

REPORT by Professor RONALD ROSS, C.B., F.R.S., &c. From April 1st to October 31st, 1906.

At the Tropical Research Laboratories of the School at Runcorn the workers have been Dr. J. L. Todd, the Director; Dr. Breinl, Dr. Kinghorn, Dr. Tobey, Dr. Hanington, and Captain R. Markham Carter, I.M.S. They have been engaged upon various minute investigations on trypanosomes and spirochaetes, besides studying the large amount of material brought back by Dr. Todd from his recent expedition. For the purposes of these researches, and also for those of teaching at the University, six species of trypanosomes, and three of spirochaetes have been kept constantly in cultivation. The bulk of the investigations have been recorded in Memoir XXI. of the School, containing approximately 120 pages, and nine full-page plates, besides numerous charts—this volume being now in the press, while another report of approximately the same size based on the material collected in the Congo Free State, is already in the printer's hands. It is not possible to give in a short space adequate details of the large amount of work done under these heads during the six months.

In the middle of May I proceeded to Greece in order to advise the Lake Copais Company how to reduce malaria in the vicinity of its premises in that part of Greece. After carrying out the necessary investigations I returned to Liverpool within one month, and advised the School to make efforts to support the Grecian Malaria Society in its campaign against the disease. The work promises to be of great importance, as if successful it will afford a signal instance of the value of modern methods; and, I may add, that owing to the aridity of Greece, the task should be comparatively easy, while malaria is so intense in the country that success will be a great boon to it. During the vacation, researches have also been conducted by me in association with Messrs. Moore and Walker, of the University Cytological Department, on centrosomes and certain other structures found by us in red corpuscles of the blood. These researches are likely to prove of considerable importance in diagnosis of disease. Our paper on the subject will shortly be published.

As usual I have been much occupied with a large correspondence in connection with tropical medicine and sanitation, and in writing articles on the subject and addresses to learned societies, all of which have the advantage of instructing the public on such matters.

 APPENDIX V.

(1.)

LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received May 19, 1906.)

SIR,

Dreadnought Hospital, Greenwich, S.E., May 18, 1906.

IN accordance with the arrangement entered into between the Colonial Office and the London School of Tropical Medicine in regard to the teaching of helminthology and protozoology, I have the honour to enclose herewith reports of the work done in these departments during the last six months.

During the year one paper has been published by the Helminthologist, Dr. R. T. Leiper, namely:—"The influence of Acid on Guinea Worm Larvæ encysted in Cyclops," a copy of which is enclosed herewith.

I am, &c.,
 • P. MICHELLI,
 Secretary.

Enclosure 1.

Helminthological Department, School of Tropical Medicine,
 SIR, Royal Albert Dock, London, E., April 22, 1906.

I HAVE the honour to submit my third half-yearly progress report as Helminthologist at the London School of Tropical Medicine.

In August last (1905) under instructions of the School Committee, I proceeded to West Africa to investigate the filarial disease Dracontiasis, returning to London at the close of the year. Early in January (1906) I received notice to prepare to leave for Egypt at an early date, to pursue helminthological studies there, under Professor Looss. The period to report has been, therefore, almost entirely spent abroad.

The report recounts:—

- (1) The investigations on the Gold Coast, West Africa.
- (2) The work in Cairo, under Professor Looss.

(1) Dracontiasis is a disease with a remarkably prolonged incubation period, extending over almost a whole year, according to our present information. This postpones for six months still the results of the experimental part of the inquiry. Until these are obtained a full and final report must be held over.

In order to inform the Committee of the main lines of the inquiry a preliminary account is now given of the conclusions arrived at and of the experimental work proceeding.

Knowledge of the Disease at the commencement of the Inquiry.

The disease is caused by the eruption of the female Guinea worm at some part of the body, and particularly in the lower extremities, the purpose of the eruption being the discharge of the young, and thereby the subsequent spread of the species. The further history of these young worms and the mode of their re-entrance into man has been explained in various ways:—

- (i.) The embryos regain their final host directly without preliminary development by (a) perforation of the skin; (b) through the mouth.
- (ii.) They first undergo changes in an intermediate host, and subsequently gain access to man (a) through the skin; (b) in drinking water.
- (iii.) They require a second intermediate host to complete their "extra-corporeal" development.

All these theories have in turn been supported by investigators. All efforts to cope with the disease must remain paralysed from want of a proper objective for prophylactic measures. These can only be instituted when the life history of the parasite is properly known, and the actual mode of entrance into the human body finally determined.

The main purpose of the present investigation is to decide these essentials.

Conditions necessary for the Vitality of the Freshly Discharged Young.

Almost immediate access to Water.

The freshly discharged young find their normal habitat in water, in which they move freely and actively.

Here they can remain alive for several days, in mud longer than in pure water, although the majority do not survive the third day in the tropics. Contrary to the generally accepted opinion, *they do not withstand desiccation*; this has been demonstrated by repeated experiments; consequently *it is impossible for the embryos to be carried about by dust*; they must gain direct access to water. The readdition of water to embryos exposed to natural evaporation on glass slides failed to revive them.

Fresh Water an Essential.

The presence of numerous lagoons on the Guinea Coast has been supposed to have some correlation to the occurrence of the Guinea worm. At Accra, a place historic as a Guinea worm centre, there are two large lagoons. The water from both

completely inhibits the movements of Guinea worm embryos in 30 minutes. The lagoons cannot therefore be a source of infection. Sea-water has a similar effect.

The direct Infection of Man negatived.

Such infection might occur in two ways:—(1) by the skin; (2) by the mouth.

It is negatived, however (a) by experiment; (b) by the known subsequent extra-corporeal changes in the embryo.

(a) Through the skin. The application of fresh embryos to the skin of the back of my hand did not produce any erythema or subsequently any localised disturbance such as occurs in other nematode infections of the skin (*e.g.*, Ankylostome infection).

(b) By the mouth. Plehn's supposed experimental production of an immature Guinea worm by feeding a monkey on fresh embryos has been repeated. The monkey is housed at the London Tropical School for further observation.

An Intermediate Host essential for continued Life.

Even in fresh water, however, the Guinea worm embryos undergo no developmental change. They are, moreover, unable to exist longer than a few days, unless they gain access, as first shown by Fedschenko, to an immediate host.

Cyclops the only efficient Intermediate Host.

Experiments were made with a large variety of invertebrate forms—Vorticellæ, Ostracoda, Daphnidæ, and other crustacea. Turbellaria and larval oligochaets. Larval mosquitoes. Cyclops. The last two forms alone seemed to have any attraction or liking for the embryos. The larvæ of mosquitoes consumed the embryo in such numbers that in a very short time the contents of their intestines were one writhing mass. Nevertheless no infection took place, the undigested cuticles being voided in a few hours. We conclude:—

The larvæ of mosquitoes are natural enemies of the Guinea worm young.

Cyclops, on the other hand, became the host, and in an hour or thereabouts the embryos can be seen in the body cavity.

Method of Infection of Cyclops.

My observations cast considerable doubt upon the generally accepted mode by which the Guinea worm embryo is reputed to gain entrance to the body of its intermediary host. The opinion I hope to more fully substantiate by an examination of preserved material is that infection really takes place through the mouth and intestine of the Cyclops. At no time was I able to observe any indication of the perforation of the cuticle by an embryo.

Stage at which the Cyclops can be infected.

Fully mature and sexually ripe Cyclops are easily infected by the Guinea worm embryo. The suggestion recently made by an author at the British Medical Association (see B.M.J. Report) that the embryo could only gain access at the time of ecdysis is therefore incorrect.

Distribution of Cyclops in Water.

The Cyclops by their active movements progress rapidly through the water; they do not sink to the bottom, but frequent the surface, particularly when the water becomes stagnant. On the contrary, the Guinea worm larvæ are unable to sustain themselves for a long period in water, and are invariably found in the lower layers.

The Cyclops is then an active agent as well as a passive medium in the dissemination of the disease, for it is from the surface of the water that the native takes his supply; moreover, when, in the dry season, the water begins to stagnate, the Cyclops will seek the surface of the pools. It is just at this period that statistics show infection to be most common.

Development within the Cyclops.

The early stages do not differ materially from the descriptions given by Fedschenko and Manson. In West Africa the process goes on more rapidly. There are *two* ecdysis—one occurring on the 7th-9th day, a second on the 10th-11th day. Thereafter no gross changes are observable, but a progressive histological tissue differentiation takes place. After the fourth week very little difference of any kind is noticeable, and embryos were kept alive for 41 days. They are, in fact, now according to their structure mature larvæ, and no further change is necessary. They now measure .6 mm. in length (not 1 mm. as given by Fedschenko).

Further Fate of the Mature Larva.

The mature larva does not actively migrate from the body of its host, and even on the death of the Cyclops it remains imprisoned and dies, with one exceptional circumstance, which indicates the probable natural conclusion of the Guinea worm's extracorporeal life, this is suggested by:—

The Action of Hydrochloric Acid on the Imprisoned Larva.

When an infected Cyclops (of about 30 days) is placed in .22 hydrochloric acid the quiescent larvæ it contains are stimulated into marked activity; at the same time, this strength of acid destroys the Cyclops. Now this is the natural acidity of the human stomach. If such acid medium is a necessity in the further progress of the larva's life, we must conclude that by the agency only of the digestive juices can the larval worm be released to continue its further development in the human body. Infection *must* take place through the mouth.

Upon these three facts—the failure of the embryo to withstand desiccation, the Cyclops as intermediate host, the subsequent infection by the mouth—can be based adequate prophylactic measures.

An endeavour has been made to obtain direct experimental support for the conclusions deduced from these artificial experiments.

Two monkeys were fed upon bananas containing Cyclops of 28 and 35 days' infection. They have been safely landed in England, and are now under observation at the London School of Tropical Medicine. A positive result cannot be expected until about October or November of this year.

It ought to be stated that failure will not necessarily invalidate the artificial experiments, though it will deprive them of the additional support necessary to place the conclusions drawn beyond criticism. It is well known how extraordinarily limited some parasites are in their efficient hosts, and in literature there is, so far as I know, at present no record of the occurrence of the Guinea worm in monkeys.*

During the search for embryos for the above experiments, material was accumulated for a review of our knowledge of the anatomy of the adult parasite. This has not as yet been fully worked up, but one observation may be now recorded which should prove of morphological interest. I have been able to satisfy myself that the adult female does not discharge her young either by simple rupture of the integument or through the mouth as has hitherto been supposed. My specimens show the "pellucid tube" or uterus to be protruded through a separate opening very close to, indeed, but distinct from, and situated outside of, the circumoral ring of papillæ.

As the uterus becomes protruded the head portion is pushed aside and quickly destroyed, so that the uterus appears afterwards in the situation of the mouth. That these facts have not previously been ascertained is due to the extreme rarity with which one gets the worm just as it is breaking the skin. The severe symptoms which force the patient to seek advice only occur later when the head has been destroyed and sepsis has invaded the body of the worm.

* Since Dr. Leiper's report was sent in, the evidence for regarding the stomach as the portal of entry for the guinea worm has been materially strengthened. The monkeys referred to in the text have been lodged at the London School of Tropical Medicine. About the middle of May one of them died of tuberculosis. The body was carefully dissected and in the connective tissue miniature filariæ males and females, as far as an ordinary naked eye examination could determine, having all the anatomical features of the guinea worm were discovered—two entire females over a foot in length and three males of very much smaller dimensions. These parasites have been preserved, their full description being reserved for Dr. Leiper.

This determination of the situation of the female opening finally disposes of Charles's contention that the male Guinea worm remains attached to the female like the male "Syngamus" at the junction of the anterior and middle third of the body. It confirms, on the other hand, Manson's interpretation of Charles's observation, viz., that the supposed "male" is really an extravasated part of the genital tube.

In addition to the formal investigation of the expedition a collection was made of parasites of the mammals, birds, and reptiles of the neighbourhood of Accra, and remains for future description.

Through the courtesy of the Senior Medical Officer I was also afforded facilities for examining all the cases of interest which passed through the Colonial Hospital, and from a *post-mortem* I obtained material which enables me to add another, though maybe extraneous, observation which is of considerable geographical interest, viz., the occurrence of the so-called "New" World Hook worm on the Gold Coast, West Africa.

In my previous report (August, 1905) I gave a summary of the results of an examination of the fæces of the Pygmies of Central Africa. I drew attention to the differences in the measurements of the "Ankylostome" ova there found and those of the ova of the European form, and suggested the possibility of their being of different species.

After my report was forwarded Professor Looss (who had had evidently an opportunity of examining also the adult worms) published a note on the subject pointing out these differences, and stating that an examination of the adult proved them to be *Necator americana*.

Looss suggested that the "American" form had been originally transported from Africa.

My observation of the *Necator americana* confirms Looss's supposition. The Gold Coast in old times was part of the recruiting area of the American slave trade. The introduction of the Ankylostome into the New World was part of the evil accompanying the importation of West Africans as slaves.

An account of the work proceeding under Professor Looss will fall more naturally to be reported in the yearly report next October. It consists in the histological examination and morphological identification and differentiation of species. Up to the present these families, Ascandæ, Oxyundæ, Strongylidæ, have formed the main basis of study. It is proposed to review the other groups in a similarly detailed manner; to make experimental studies of the life histories of some of the more important parasites and to conduct researches upon the Egyptian parasites of man and the domestic animals.

I have, &c.,
ROBERT THOMSON LEIPER.

Cairo, April 21, 1906.

Enclosure 2.

REPORT OF PROTOZOOLOGIST FOR SIX MONTHS ENDING APRIL 30TH, 1906.

During the past six months part of my time has been occupied in studying at the London School of Tropical Medicine, and part at the Pasteur Institute, Paris.

Since the 15th of March I have been studying protozoology under the direction of Professor Mesnil. During this time I have been familiarising myself with the methods used by Professor Mesnil in the study of the Protozoa, and concurrently have been conducting under his guidance a research upon the action of certain drugs on Trypanosomiasis.

This work at the Pasteur Institute I hope to continue through three to four months.

During the four and a-half months previous to my coming to Paris I was occupied partly in repeating work that had been done by other investigators and partly in carrying on investigations of my own along certain lines. My departure to Paris has caused these investigations to be suspended for a time, and their completion must be reserved for a future date. This work has had reference to three groups of Protozoa, viz., the Amœbæ, more especially with regard to their cultivation as indicated by Musgrave and Clegg; the Sarcosporidia, chiefly as they infect cattle imported into England, and the Spirochætæ as occurring in relapsing fever, the opportunity for which study was given by four cases in the wards of the hospital at the Albert Dock. In addition to the *Spirochæta obermeiri* of relapsing fever, I have been studying a spirochæte, hitherto undescribed, which I have found infecting the blood of mice, and also a second spirochæte, also new, which I found in films of the blood of the Nagoe antelope of Central Africa. Beyond this I have made a regular examination of the blood of animals with the result that I have found hæmogregarines in the blood of a crocodile, snake, and lizard. These species are not yet determined, and finally I have been describing a parasite discovered by Gerrard in the blood of a dog in the Malay Straits, and which is evidently identical with that described by Bentley and James as the *Leucocytozoon canis*.

I will now indicate under their respective heads the chief points of my investigations mentioned above:—

Amœbæ.—My work on these Protozoa was undertaken after the publication of the most interesting results of Musgrave and Clegg. I have been occupied chiefly with the cultivation of Amœbæ, and so far my work has been confirmatory of these authors. I have successfully cultivated Amœbæ from several distinct sources upon their medium. Two species of water Amœbæ grew without difficulty, and I was able in the case of one of these to obtain a culture which was started from a single individual. In this way I obtained a definitely pure culture of a single species of Amœbæ. The method of transplanting single Amœbæ recommended by Musgrave and Clegg I found awkward and difficult of application, but I was able to devise a method which to my mind is simpler and more accurate.

I was also successful in cultivating a single species of Amœbæ from the intestine of the Guinea pig, and finally one from a case of amœbic dysentery in the wards of the hospital.

Sarcosporidia.—My work upon these parasites was directed chiefly to a species which was found in the muscle fibres of oxen in the Deptford Cattle Market. By examination of the muscles of oxen slaughtered there I was able to determine that practically without exception all the cattle were infected. The muscles chiefly involved were those of the œsophagus and heart. Muscles in other parts of the body were also infected, but to a less extent. The animals slaughtered were usually young and the sarcosporidian cysts were small. On one or two occasions old bulls were slaughtered, and in these animals the cysts were larger. It would thus appear that the cattle became infected when young and that the Sarcosporidia can continue to grow through many years without producing any noticeable effect upon their hosts, and my attention was also directed to the development of the spores from the multinucleated protoplasm which constitute the body of the Sarcosporidian.

In the case of the spores I was unable to obtain by any means the extrusion of the filament, though the spiral striation of the polar capsule, described by Laveran and Mesnil was visible in the fresh condition, I was not able to observe any movement of the spores.

Spirochæta.—Several cases in the wards gave me an opportunity of making some experiments upon the mode of transmission of relapsing fever. It has been thought by many that the virus is conveyed from person to person by the bite of the common bed bug. A supply of these animals having been obtained, they were allowed to feed upon a patient whose blood was infected with the spirochæte. By examining these bugs from time to time I found that the Spirochætæ existed in the normal condition in the body of the bug for as long a time as three weeks. My supply of bugs being small I was not able to continue these observations for a longer time than three weeks. Several of the bugs were kept for feeding upon a monkey and this was done about two months after they had fed upon the blood. The bugs were then in an unsatisfactory condition. The monkey did not become infected, and an examination of the bugs revealed no spirochætæ in their bodies.

Two months later two other patients were admitted to the hospital suffering from the same disease. The experiments with the bugs were repeated, and they were allowed to feed upon a monkey a week after feeding upon infected blood. This time also the infection of the monkey was equally unsuccessful.

After the admission of the last-mentioned patients to the hospital I made a visit to the ship from which they had come. I found that the two men had slept in bunks in one corner of the forecastle where there was a stove. This corner was the warmest in the forecastle, and the bunks occupied by the patients were the nearest to the stove. I made a careful investigation of the bedding and bunks, and was successful in finding two bugs in the bed of one of the patients. An examination of the bugs failed to reveal the presence of any spirochætes, though it was clear that the bugs had recently fed.

The position and arrangement of the bunks and the fact that bugs were the only biting creatures found there are in favour of these animals being the transmitters of the disease.

Spirochæte of Mouse.—While examining a blood preparation of a mouse infected with *Trypanosoma dimorphon*, I was surprised to see some very fine and active spirochætes moving about amongst the blood corpuscles. Their movements were so rapid that little could be made out in the fresh blood; their presence was noticed by the movement given by them to the red corpuscles, and every now and then a glimpse of a typical spirochæte was caught. On staining a blood film the spirochætes were seen to be short and their thickness about that of *Spirochæta obermeiri*, the longest form only reached the diameter of a red blood corpuscle. They showed from two to six undulations of the body, and were slightly tapering at either extremity. No flagella were seen. Staining with Giemsa was uniform, and there was no indication of a nucleus. In the larger forms a clear spot could be made out at the middle, and this was clearly the commencement of transverse division. No sign of longitudinal division could be made out.

The presence of this spirochæte in the blood along with a *Trypanosoma* was very interesting from the point of view of the relations existing between these two forms of parasite.

When blood from the mouse was injected into other mice, these became infected with Spirochætes and Trypanosomes, but I noticed that the Spirochætes showed themselves in $4\frac{1}{2}$ to 5 days, while the Trypanosomes did not appear till a day or two later. Advantage was taken of this, and a mouse was inoculated; directly Spirochætes appeared in its blood, some of it was inoculated into a fresh mouse, and in this way I obtained a pure infection with Spirochætes. The incubation period appears to be $4\frac{1}{2}$ to 5 days, and the infection, as far as I have tested it, lasts a month and probably longer. So far, I have inoculated a dozen mice with infected blood, and in every case Spirochætes appeared about the fifth day. The infection appears to have little effect upon the mice. It is evidently a mild chronic affection, and in this respect resembles the infection of rats with *Trypanosoma lewisi*.

This work upon the Spirochæte of the mouse I have been conducting at the Pasteur Institute.

No papers on the work outlined above have as yet been published, as most of it is still incomplete. After my time of study abroad is completed, I shall be able to take up afresh these investigations and bring them to completion.

C. M. WENYON.

Enclosure 3.

Reprinted from the "BRITISH MEDICAL JOURNAL," January 6th, 1906.

THE INFLUENCE OF ACID ON GUINEA WORM LARVÆ ENCYSTED IN CYCLOPS.

By ROBERT T. LEIPER, M.B., F.Z.S., Helminthologist at the London School of Tropical Medicine.

The practical study of dracontiasis, one of the oldest known and, in some regions, the most prevalent of tropical diseases, has been singularly neglected,

Although not a fatal disease or one which attracts much sympathy, its incidence nevertheless is commonly the precursor of much suffering and physical incapacity. Modern methods of treatment are at once so unsatisfactory and necessarily prolonged and so inaccessible to the vast majority of

sufferers that it can only be from the application of prophylactic measures that the diminution or eradication of the disease is to be expected.

In dracontiasis a knowledge of the life-history of the *Filaria medinensis*, and particularly of the stage and manner of its entrance into the human body, must form the essential basis on which such measures may be framed, yet Manson appears to be the only observer who has made any important contribution to Fedtschenko's original discovery of cyclops as the intermediate host thirty-six years ago.

Based on many theoretical considerations, but especially influenced by the recent discovery that the young stages of certain worms, such as *Ankylostomum duodenale* and *Strongyloides intestinalis*, make their way into the body of their host through the follicles of the skin, modern scientific opinion has become more and more prepared to postulate a like mode of entry in dracontiasis, while at least one authority has suggested that a second intermediate host might even be necessary. In view of the fact that a discussion in which these theories were in turn maintained took place on this subject at the last annual meeting of the British Medical Association, and was recently fully reported in the "British Medical Journal," thus attracting considerable attention, I am induced to publish somewhat in advance an observation made by me while studying this disease on the Gold Coast, which seems to throw suggestive light on the question.

The embryos of *Filaria medinensis* during the first fortnight of their stay in the body-cavity of cyclops—that is, during their entire metamorphosis—continue to exhibit active vermicular movements. They also not infrequently change in position. During the third and fourth week, however, these changes gradually cease, and ultimately the larva lies almost wholly quiescent. If a cyclops containing such a larva be placed on a slide in a very small drop of water, and if, while it is being watched under the low power of the microscope, there is added some 0·2 per cent. hydrochloric acid, representing the acidity of the gastric juice, a remarkable change will be seen to take place. The cyclops is gradually killed, showing little motion beyond a few tremors of the antennae and rami. On the other hand, as the acid penetrates, the apparently quiescent filaria regains its former activity. At first slowly, but with every moment with increasing strength and rapidity, it coils, stretches, and recoils, until at last, having divested itself of what probably is the remains of a very delicate cuticle, it bursts into the general body cavity of the now moribund cyclops, and in a very short time completely destroys the organized contents by its increasingly violent motions. The larva is soon seen to be testing with obvious purpose every joint of the cuticular integument. At one moment it is attempting to advance along the entire length of a narrow antenna, at the next it may be found attacking one or other of the prolongations of the bifurcated tail. Retreating again, it will endeavour to ascertain the patency of the anus, the genital openings, or the mouth. By one or other of these apertures, or, in some cases, it may be by a rupture of the cuticle, the young worm eventually reaches the exterior, and there swims about with great rapidity like a minute snake. One specimen, watched for three hours, continued with brief rests, in which it coiled and uncoiled, to manifest the same marvellous vitality.

In contrast, other cyclops containing embryos of the same date of infection, and in all respects similar to those used in the above experiments, were kept alive for a further period of two weeks—that is, until six weeks old—but their contained larvae did not exhibit change either in complexity or in gross increase in size. Some of these cyclops died in the meantime, but the guinea worm embryos did not appear to escape; they were also found dead.

This experiment seems to indicate—in so far as an artificial experiment may—that the *Filaria medinensis* is introduced while still in a quiescent state in the body of cyclops into the stomach of the human host, whence on being set free by the influence of the gastric juice, it proceeds to its further development within the body.

(2.)

THE LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received November 8, 1906.)

SIR, Dreadnought Hospital, Greenwich, S.E., November 7, 1906.

IN accordance with the arrangement entered into between the Colonial Office and the London School of Tropical Medicine in regard to the teaching of Helminthology and Protozoology, I have the honour to enclose, herewith, reports of the work done in these departments during the last six months.

I also enclose a copy of Dr. Leiper's paper—"The Etiology and Prophylaxis of Dracontiasis," and a copy of the Journal of Hygiene, which contains Dr. Wenyon's article entitled "Spirochaetosis of Mice due to *Spirochaeta muris* N.S.P. in the Blood." Dr. Leiper's paper, read before the British Medical Association, shall be forwarded in due course.

I am, &c.,
P. MICHELLI,
Secretary.

Enclosure 1.

LONDON SCHOOL OF TROPICAL MEDICINE.

REPORT OF HELMINTHOLOGIST FOR THE SIX MONTHS ENDED 31ST OCTOBER, 1906.

I have the honour to submit my fourth half-yearly report as Helminthologist to the London School of Tropical Medicine.

The experimental enquiry into the life history of the Guinea-worm begun by me last year at Accra in West Africa, and to which reference was briefly made in my last report, has now been closed, and the results of the investigation have been embodied in two papers:—

- (1.) "Some results of the infection of Monkeys with Guinea-worm," read in August, 1906, at the British Association for the advancement of Science.
- (2.) "The Etiology and Prophylaxis of Dracontiasis," sent to the Press for publication.

In the former paper a preliminary account is given of the anatomical structure of the *Filaria medinensis*, based upon material obtained post mortem from a monkey infected, six months previous to its death, with Guinea-worm larvæ, and also from an examination of adult specimens removed from patients in West Africa. It records the finding of the *male* worm in the tissues of the experimentally-infected monkey, and adds several new facts to the present knowledge of the structure of the female *Filaria medinensis*.

The latter paper discusses the Etiology of Dracontiasis, and reviews all the principal theories that have been held regarding the life history of the Guinea-worm. It confirms with experimental evidence the fact that the larvæ of the Guinea-worm cannot continue to develop or to live for more than a very short time without the assistance of an invertebrate host, that the species of Cyclops only can act as the intermediary host, and that no other host is required to continue or complete the developmental changes begun in the body cavity of the Cyclops as the larvæ attain their full larval evolution there. It has been found that, contrary to previously held views, the embryo Guinea-worm is incapable of resisting desiccation, even for a short time, or of existing in water that contains an appreciable amount of salt. The embryo, when discharged from the eruption in the skin of the patient, must gain direct and immediate access to fresh water, and must, within three days, make its way into the proper host.

The result of the infection of a monkey with Cyclops containing mature larvæ confirms the conclusion previously arrived at from artificial experiment that the parasite gains its entrance into the human body through the medium of the alimentary tract.

The discovery of the male worm in the tissues of the host disposes of the many theories that have been propounded to explain the fact that only the ripe female worm has been hitherto found in the cases of Dracontiasis. The male worm is small and lives in the deeper connective tissues of the body. After it has performed its function it probably dies, and is absorbed or becomes a calcified mass.

In the successfully-infected monkey the female Guinea-worms were found in the limbs, although they were still immature and quite lacking in sexual products. This distribution in the dependent parts has led me to suggest a new explanation for the extraordinary frequency of the eruption in Dracontiasis taking place in the lower extremities. In many of the lowly organised creatures the movements are definitely controlled by reactions to external conditions. These reactions are called tropisms, viz., Heliotropism, Stereotropism, Chemotropism, Geotropism, &c. In the case of the Guinea-worm it appears to me that we have an example of Geotropism that has become highly developed through the influence of natural selection acting potently through the necessity for water to continue the life of the species. The Guinea-worm progresses towards the feet, according to this view, not from an instinctive knowledge that she will find most ready access to water in the lower limbs, but is impelled to move in a definitely earthward direction by a purely physiological reflex that is common in many of the lower forms of animal life.

The facts ascertained in the course of this study of the etiological factors controlling the larval life of the parasite have permitted the tabulation of the conditions that are essential to its development, and so provided us with the data upon which to found the means for the prevention of the spread of the disease. The paper concluded with a description of the local conditions that appeared to me to encourage the spread of Guinea-worm in the eastern portion of the Gold Coast, and with some suggestions as to the manner in which these might be altered.

The six months that have elapsed since the presentation of my previous report have been occupied with the study of Helminthology under Professor Looss in Egypt. During the vacation, however, while Professor Looss was on holiday, I returned to England for four weeks in order to examine the material obtained at the post mortem of the infected monkeys, and to bring together the results above reported upon.

The work in Cairo has consisted for the most part in the examination, identification and differentiation of local species of parasites. Particular attention was devoted to those that produce pathological effects in the higher animals. Over eighty species were so examined. Some experiments in the development of Trematoda have also been commenced. During the course of these studies some apparently original observations were made, the material being preserved and placed on one side for future and more detailed examination.

I have endeavoured to make myself familiar with the naked-eye appearances of the lesions caused by the helminthes by periodic visits to the public abattoir, and have had thus many opportunities of becoming efficient in the best methods of obtaining and preserving material for subsequent investigation.

In my previous reports I have recorded the occurrence in Africa of the American ankylostome—*Necator americanus*, first from the Congo and later from the Gold Coast. Through the kindness of one of my correspondents I have recently been enabled to examine the ankylostomes of North-West Rhodesia, and find that the *Necator americanus* occurs there also. It is evident, therefore, that a form which until 1905 was considered to be a purely American parasite is widely spread over the African continent. Requests have been sent to British East Africa for material and also for ankylostomes from Uganda. It seems not improbable that a world survey would reveal the *Necator* as a tropical form in various parts of the world.

School of Medicine, Cairo,
October, 1906.

ROBERT T. LEIPER.

Enclosure 2.

LONDON SCHOOL OF TROPICAL MEDICINE.

REPORT OF PROTOZOOLOGIST FOR THE SIX MONTHS ENDED 31ST OCTOBER, 1906.

Zoological Institute, Munich, October, 1906.

During the past six months I have completed the course of study under Professor Mesnil of the Pasteur Institute, Paris, and since September 15th have been working in the Laboratory of Professor Richard Hertwig in the Zoological Institute of Munich University.

At the Pasteur Institute my work was directed chiefly along experimental lines and I was occupied in acquainting myself with the methods and technique employed in experimental investigations. Concurrently I continued the research I had commenced in March on the action of the colours of benzidine on *Trypanosoma dimorphon*, and in following up the life history of the spirochaete I had found in the blood of mice.

Under Professor Richard Hertwig I am studying chiefly the morphology of the protozoa, with special reference to their minute anatomy and the methods employed in their investigation. I am also working upon the protozoan parasites which inhabit the intestines of mice. Many of these parasites are closely allied, if not identical with, similar parasites which occur in man.

I will now indicate, under the headings of:—

- (1) *Trypanosoma dimorphon*, and
- (2) *Spirochaeta*,

the chief results of my investigations on these two parasites.

(1) *Trypanosoma dimorphon*.—The work under this heading consisted in an investigation of the action of certain benzidine colours (54 in number) on this trypanosome as occurring in experimentally infected mice. Professor Mesnil, in conjunction with Dr. Nicolle had been working with these colours in infections produced by the trypanosomes of nagana, surra, mal de caderas, and sleeping sickness, a work they had undertaken after the publication of Ehrlich and Shigas researches on the action of trypanroth—one of the benzidine colours—on mal de caderas. Professor Mesnil and Dr. Nicolle had found that for the first three of the above-mentioned trypanosomes the blue colour “Cl” gave the best results, while for the trypanosome of sleeping sickness it was another blue colour “Ph” which was most active. The results of my investigations on *Trypanosoma dimorphon* are interesting in showing that this trypanosome differs in a striking manner from those mentioned above. In experimental mice the infection produced by this trypanosome is of a sub-acute or chronic type and in this respect differs from the infection produced by the trypanosomes of nagana, surra, and mal de caderas, and resembles more that produced by *Trypanosoma gambiense*. In the reaction to the benzidine colours a still greater difference is found to exist. In the case of the other trypanosomes the blue colours Cl. and Ph. are most effective, while on *Trypanosoma dimorphon* they have little action, and generally do not even cause a reduction in the numbers of trypanosomes present. In the case of this trypanosome it is the red colours which have the greatest therapeutic value. The method of investigation was as follows:—

Mice were inoculated with infected blood. Their blood was examined daily, and on the second day of their infection each mouse received a dose of colour, this dose usually being 1 cubic centimetre of a 1 per cent. solution of colour in distilled water for a mouse weighing from 15 to 20 grams. If the colour was active it was found that the trypanosomes diminished in numbers or disappeared completely from the blood. In the former case the trypanosomes were much altered in appearance and many were found in processes of degeneration. In the great majority of cases, where there was a complete disappearance of the trypanosomes from the peripheral blood, they remained absent only a few days and then again appeared. These trypanosomes of the relapses were altered in some way as the mice were able to tolerate the presence of a greater number, and these for a longer time, than would have been the case if they had not been treated.

With the red colour *a* the large proportion of mice treated were completely cured. This colour was well tolerated by the mice. It caused no necrosis or sloughing of the skin and was only toxic in large doses when it caused the death of the mice through a form of nephritis where the cells of the convoluted tubules of the kidney became packed with red granules and finally disintegrated. This colour *a* was the only one of the 54 colours tested which cured mice after the administration of a single dose. Not all the mice treated with *a* were cured. Some relapsed, and to these a further dose was given, but though the trypanosomes disappeared a second time, it was only for a shorter interval. In the treatment of the second and third relapses the trypanosomes became tolerant of the drug which might then have no action whatever.

These promising results with *a* led me to adopt a modified method of treatment. This consisted in giving repeated doses of colour at intervals of a few days. Doses were given at intervals of 3, 5, and 8 days in three series of mice. In this case none of the mice relapsed. The same method of treatment was tried with the next four best colours, but was only successful in the case of one mouse which had received three doses of trypanroth.

The effect of *a* in repeated doses was also tried on two other distinct strains of *Trypanosoma dimorphon*. The results obtained were the same as for the first strain.

These results show that it is possible to cure mice infected with *Trypanosoma dimorphon* by means of the colour 'a'. It still remains to be seen whether 'a' would give similar results in other and larger animals.

Trypanosoma dimorphon occurs in horses and other animals in various parts of Africa (Gambia, Soudan) causing a mortality which is quite considerable. It is to be hoped that the application of this colour treatment will be of some practical good.

(2) *Spirochaeta*.—This spirochaete I had discovered in mice shortly before my last report was written. It was found in the blood of mice infected with *Trypanosoma dimorphon*, but I was, fortunately, able to obtain a pure infection. A series of inoculation experiments was made. In all about 50 mice were inoculated with infected blood and, in every instance, after an incubation period of 5 to 6 days the mice became infected. The spirochaetes were present at first in small numbers, but these gradually increased during the following few days till as many as six or seven were present in each field (Zeiss D objective). The numbers then gradually declined. Even after 3 or 4 months an occasional spirochaete could be found. The presence of the spirochaete did not appear to have any harmful effect on the mice. Attempts were made to infect guinea-pigs and adult rats, but without success. In two young rats an infection was induced.

I was not successful in discovering the natural mode of transmission of this spirochaete. Mice fed upon the blood and organs of infected animals did not contract the infection. The spirochaete was found in lice which lived upon the mice, but it was not possible to transmit the infection by their means. Large numbers of spirochaete of various forms live in the intestine of mice and it was thought that possibly some of these had migrated to the blood. To test this possibility, mucus from the intestine of mice in which were active spirochaetes was inoculated in several mice, but none of these became infected.

The results of these experiments have been published in the Journal of Hygiene for October.

C. M. WENYON.

Enclosure 3.

THE ETIOLOGY AND PROPHYLAXIS OF DRACONTIASIS.

By R. T. LEIPER, M.B., F.Z.S., Helminthologist to the London School of Tropical Medicine.

Dracontiasis is very common and widely disseminated throughout the native races of our West African possessions. During the last five years it has twice assumed epidemic proportions amongst the black troops stationed there, and on the more recent occasion severely hampered military operations in Nigeria.¹ These outbreaks indicate how, by aggravating the difficulty of maintaining the necessary supplies of labour, the disease may materially retard the commercial development of these colonies in the future. The authorities are at present deterred from initiating any active prophylactic measures by the varied and conflicting nature of the theories now in vogue as to the life-history of the parasite, and the manner in which it gains access to the human body.

In order to investigate these points in more detail, and, if possible, to determine the means by which the disease might be mitigated or controlled, I was sent to West Africa in August of last year by the Committee of the London School of Tropical Medicine.

The aim of the present paper is, first, to record the results of experiments undertaken to test the truth of previous theories; secondly, to define the conditions essential to the complete development of the parasite; and, thirdly, to base upon the facts ascertained some suggestions for the prevention of the spread of the disease.

The hypotheses of infection that have been advocated from time to time may be classified as follows:—

I. Those in which the development of the embryo is supposed to occur without the intervention of any intermediate host, human infection being caused by:

- a. The embryo, as discharged from the parent worm; or
- b. The mature larva, evolved from the embryo in water or marshy soil; or
- c. The young adult, the product of the continued growth of the larva in water.

II. Those in which an intermediate host is considered essential for the development of the larva in order that it may become fitted to reinfect man:

- d. The only, and in itself sufficient, host being cyclops.
- e. A second, and at present unknown, intermediate host being necessary to continue and complete the changes begun in cyclops.

Further, there remains to be considered under each heading a still more controversial and important question: By what route does the parasite enter the human body? Does it do so passively with the ingestion of fluid or actively by penetrating the skin?

The theories comprised in Section I. have been strongly advocated by many writers on dracontiasis in the past. They are still to be found in some of our modern textbooks of pathology, though they have become discredited. Plehn² is the most recent investigator to support the theory (A) of direct infection by the embryo. In a tumour of the right thigh of a monkey which had been fed eight months previously on bananas containing freshly discharged embryos he found a filaria "indistinguishable from the Medina-worm." This experiment I repeated in Accra, but though the monkey swallowed thousands of living embryos, not a sign of infection could be discovered *post-mortem* six months afterwards. Busk³ has maintained on clinical evidence that the embryos directly penetrate the skin, but I am unable to support this view. The application of living embryos in water to the dorsum of my own hand always failed to produce the erythema and itching noted by Looss to accompany skin infection by nematode larvae, and there have as yet been no other indications of infection.

The remaining hypotheses (b and c) of this section may be rejected from a critical examination of their literature. It is obvious both from the descriptions and illustrations that the larvae and adults of certain free-living nematodes have been very generally mistaken for the developing Guinea-worm. The same explanation disposes of the statement (Carter) that *Urolabes palustris* is the free form of the *Filaria medinensis*.⁴

It has frequently been shown that the embryos discharged from the parent can only live in water for quite a short time, and that they undergo no metamorphosis. In my observations on the vitality of these embryos in water the vast majority died on the third day, though some survived until the sixth. In mud they lived a day or two longer, probably because in this they move more slowly, and are consequently less quickly exhausted. Although provided with a mouth and digestive tract they are still unable to obtain food for themselves.

This inability on the part of the embryo to infect man by the skin or by the mouth, to undergo any further development, or even to remain alive in water, points to an intermediate host as an *essential* factor in its life-cycle.

This conclusion brings us to the consideration of the theories in Section II. The conditions under which the embryo becomes a larva were discovered by Fedschenko about 1870.⁵ He observed that the embryo made its way into the body cavity of a small crustacean of the genus *Cyclops*, and there, after a period of twelve days, underwent metamorphosis. Having followed the growth of the larva until the fourth week, he then endeavoured to complete the life-cycle of the parasite by feeding cats and dogs upon the infected cyclops. These experiments were unsuccessful. Nevertheless, Fedschenko concluded that cyclops was undoubtedly the efficient intermediate host of the Guinea-worm, and that probably the larvae were taken into the alimentary canal of man whilst still within this host, and there set free. His view was that in the intestine they then attained sexual maturity, and the females when fertilized made their way into the connective tissues, whilst the males died and were discharged in the faeces.⁶

The failure of Fedschenko's efforts to produce infection artificially led many to doubt the accuracy of his conclusions. It has been urged that "possibly cyclops is not the real host of the *Filaria medinensis*, notwithstanding that the nematode might attain a certain stage of development in its body" (Sambon⁶). Others maintain, upon the analogy of the behaviour of the ankylostome larva, that the larvae by becoming free-living later, may infect man through the skin. They are thus able to offer an explanation for the remarkable fact that the parasite occurs in the lower limbs in 90 per cent. of all the cases of dracontiasis. While my own experience does not confirm Fedschenko's observations and conclusions in their entirety it brings no support to these later views.

I obtained the materials for experimental purposes most satisfactorily by the following means. Cases of dracontiasis were selected in which the vesicle caused by the worm was still whole or had only recently burst, and a damp compress was bound over the sore. When this was taken off, a few hours later, there would be found upon it an almost solid mass of embryos. With material obtained in this way one had complete control over the degree of infection of water containing the cyclops. The worm discharged its young by a prolapse of the uterus as described by Manson,¹⁰ though this extrusion never occurred through the mouth, but by an opening just outside the circumoral ring of papillae.¹²

Cases in which there was considerable suppuration or abscess formation were useless for our purpose, the accessible part of the worm being filled by white cells, which had destroyed the embryos. To secure a supply of cyclops, likely pools were swept with a fine silk net (60 meshes to the linear inch) into the apex of which had been fitted a wide-mouthed bottle of about 10 oz. capacity. When this bottle was filled with creatures of various sorts it was emptied into large jars, which were then corked and transferred to the temporary laboratory. After a time, possibly because the oxygen became exhausted, the cyclops collected near the surface. The upper layer was then decanted into a large Petri capsule and gently "swirled" round until the solid contents gathered in a vortex in the centre. By means of a large syringe with a fine nozzle all the dirt and the innumerable small creatures could now be got rid of—except the cyclops, which always darted away from the current into the clean water at the sides. In this way it was easy to get a large and fairly pure supply from the most miscellaneous catch.

Although most of the animals that prey upon cyclops were excluded by this method, there was some difficulty still owing to the evaporation and concentration of the water, and the growth in it of paroemacia which destroyed large numbers. The bulk of the water had consequently to be drawn off and replaced by fresh every third day. Moreover, the cyclops themselves are carnivorous, and in absence of their usual food supply consume their fellows, so that it became necessary to add some organism that was suitable as food and yet harmless. The best results followed the use of rain water, which contained numerous nauplii and cladocera, to refill the tanks.

Of all the other organisms found in the ponds none was capable of infection with Guinea-worm embryos. In a few instances these were swallowed, especially by mosquito larvae, but they were invariably digested and their cuticles evacuated. Cyclops, on the other hand, was very susceptible, no resistance being met with even in adult forms carrying brood capsules. This fact provides a strong argument against the suggestion of Graham⁷ that the greater incidence of the disease in May and June is due to the prevalence in these months of young forms of cyclops, which he supposes are much more liable to infection.

I do not propose to give any account in this paper of the changes undergone by the larva in becoming mature. Such embryological details may be more fittingly considered later in connexion with the anatomy of the adult worm.

There are, however, two episodes in the embryo's life that are of sufficient practical interest to be dealt with here, and regarding which I find myself at variance with previous observers, namely, the mode of its entry into cyclops, and the time required for the completion of metamorphosis. The teaching of the present day is that the embryo bores its way through the integument at the intervals between the "ventral plates," and so directly reaches the body cavity. I was never able, in spite of repeated endeavours, to observe this process, and there are several

considerations which make it somewhat improbable. The cuticle of cyclops is continuous and almost uniform. There are no distinct "ventral" plates or intervals between them. In fact, as may be seen after the soft parts of a dead cyclops have been completely cleared away by paroemacia, the cuticle is a rigid and uninterrupted exoskeleton. The Guinea-worm embryo possesses no boring apparatus with which to pierce this resistant layer. Its movements, moreover, intermit regularly, and are insufficiently powerful to maintain its own weight against gravity. For it, the presence of a cyclops in its neighbourhood is a matter of indifference—a strong contrast to the swarming of the miracidia of trematodes around their special hosts. If by chance an embryo does come in contact with one of the cyclops's appendages it loops round it in the form of a Greek *α*, but it has no means of firmly affixing itself and quickly relaxes again. The coiling appears to me to be essentially spasmodic. It may be produced by salt solution and other chemical irritants. This peculiar flexion followed by sudden straightening, while useless for penetrating a resisting object from without, seems very well calculated to help the embryo to explode one or other of its extremities through the walls of a soft containing tube like the cyclops's intestine. Further, where more than half-a-dozen embryos gained access to the body cavity, the infection generally resulted in the death of the host. In these cases it could be seen that the intestinal wall at one part was severely lacerated. Lastly, we have the analogy of *Cucullanus elegans*, the similarity of the embryos of which to those of the Guinea-worm suggested to Leuckart⁸ the possibility that the cyclops was an efficient host for both. Although the *Cucullanus* embryo is provided with a special "perforating tooth" (Blanchard⁹), it is an accepted fact that it infects cyclops through the intestine. The question can only be settled finally by serial sections of recently-infected specimens, and these I have hitherto had no opportunity of making. Meanwhile it is, I venture to submit, at least an open one.

As regards the time necessary for the completion of metamorphosis, Fedschenko, who continued his observations into the fourth week after infection, states that it occurs on the twelfth day. Manson,¹⁰ working in London with English cyclops, found that ecdysis was postponed until the sixth week, owing, doubtless, to the cold. In Africa I found that the striated cuticle of the embryo was cast generally on the eighth day. The larva which emerged lost, two days later, a very delicate enveloping pellicle, and from that time onwards underwent *no* further ecdysis. The subsequent changes were confined to the differentiation of internal structures, the larva apparently becoming mature in the fifth week.

The next point to be considered is the way in which the mature larvae quit the cyclops. If infection of man is to occur by the skin, it is clear that they must leave the cyclops and become free-swimming. If, on the other hand, infection occurs by the mouth there is no necessity for them to do so till they arrive in the human stomach. Now, in the six weeks during which I was able to observe them developing, the larvae showed no inclination to leave the cyclops. On the contrary, as time went on they became more quiescent, and even when, as happened only too often in the later stages of the experiments, the cyclops died, they did not escape, but were found dead in its interior.

The manner in which they can be set free I have already described in a previous communication.¹¹ When an infected cyclops was transferred to a 0.2 per cent. solution of hydrochloric acid it was immediately killed, but the larvae, far from being destroyed, were awakened to great activity, and eventually escaped into the fluid, in which they swam about freely. This experiment pointed clearly to the probable way in which the larvae are released in nature, for if such a cyclops were swallowed the action of the gastric juice would give the same result.

In order to clinch the argument, I fed a monkey on bananas containing cyclops which had been infected for five weeks and which had in them larvae which appeared mature. Six months later a careful *post-mortem* examination was made for me by Dr. Daniels, and in the connective tissues five filaria were found which, as I have stated elsewhere, possessed the anatomical characteristics of *Filaria medinensis*.¹² There were three unimpregnated and obviously immature females about 30 cm. long, and two remarkable small males (22 mm.), which were obtained one from the psoas muscle and the other from the connective tissue behind the oesophagus.

These results point strongly to the truth of the theory that infection of man takes place from the drinking of water containing infected cyclops.

The suggestion⁶ that a second intermediary host is necessary for the complete development of the Guinea-worm larva is disposed of by the fact that this is actually attained in cyclops.

The finding of both male and immature female forms in the connective tissues relieves us of the more improbable alternatives previously open to us,⁹ namely, that either the filaria was hermaphrodite or that the larvae became sexually mature in the intestines, and the fertilized females only migrated into the body. The view that the larvae at once make their way through the gut wall and become sexually differentiated later in the tissues of their host, brings the after-development of the parasite much more into line with that of other filaria.

We have already referred to the extraordinary frequency of the parasite in the lower limbs in human cases, and discussed the possibility of the larva directly reaching its final position in the connective tissue by piercing the overlying skin. Those who reject this explanation suppose that the pregnant worm is attracted to these parts by a maternal "instinct" which bids her seek to discharge her young into water.¹ In the case of our monkey, however, the three female worms, although immature and unfertilized, had already made their way into the limbs, being found *post mortem* in the forearm, the axilla, and the popliteal space. I venture to suggest that in these wanderings of the Guinea-worm we have an example of one of those "-tropisms" that, as Loeb has recently shown,¹⁴ dominate the movements of many lowly-organized creatures. Geotropism¹³ seems to me to afford a rational explanation of the remarkable distribution of the parasite in man.

Two further statements must be briefly dealt with before we can proceed to summarize the circumstances controlling the complete development of the parasite. It has been repeatedly affirmed that the embryos as they come from the patient are able to withstand desiccation,¹⁰ and thus be spread widecast by the wind, or in the dry season await a favourable rain to carry them to a cyclops-infested pool. Were this true it would present an almost insuperable difficulty to the prevention of the spread of dracontiasis. The embryos are, however, immediately killed if dried by natural evaporation, and they cannot be revived by the re-addition of water.

The presence of numerous large lagoons along the Guinea coast has been thought to explain the great prevalence of the disease in that part of Africa. At Accra there are two lagoons, but neither contains cyclops. The water was distinctly saltish. This excludes them as a source of infection, for on the one hand the species of Cyclopidae are, with one or two rare exceptions, fresh-water forms, and, on the other, water taken from these sources was found to kill the Guinea-worm embryos in half an hour. Sea water had the same effect.

We are now in a position to define with some accuracy the conditions essential for the completion of the life cycle of the parasite.

The young must be discharged directly into fresh water soon after the parent worm has succeeded in creating a break in the overlying skin and before the wound has become markedly septic. The embryos must find a cyclops within a few days. They must, moreover, succeed in entering its body cavity. Five weeks later, they will have developed into mature larvae. These must, thereafter, be taken into the human stomach, and having been set free from its host by the gastric juice, reach the connective tissues by penetrating the gut wall.

The life-cycle of the parasite will necessarily be broken: (1) By the death of the embryos, either from sepsis while still within the parent worm, or after their discharge, by saltish water or drying. (2) If cyclops are not present in the water, or if the infected cyclops die or are not taken into the human stomach. (3) If the larvae, ingested by the final host, are immature or fail to escape from the chitinous sheath of the cyclops. Though they do gain their final habitat, the cycle will still be incomplete if (4) there are not both males and females among the matured adults, and if in their wanderings the females are not impregnated.

It will at once be seen from the above summary that the isolation of infective man from healthy cyclops and of infected cyclops from man must be the object of any organized effort to stamp out dracontiasis.

It is with diffidence that I offer any suggestions on the practical application of this conclusion. We must look rather to those who are intimately acquainted with the customs of the people and the physical conditions in the affected areas for proper guidance as to the means by which it can be most successfully achieved. My remarks are based on what I saw of the water supplies of the villages in the eastern half of the Gold Coast Colony during a journey from the coast at Accra to Kpong on the Volta River. The observations, necessarily somewhat limited, were made at a time of severe drought, and it may well be that measures which then seemed best adapted to the requirements may prove unsuitable or impracticable elsewhere and under other climatic conditions.

From the nature of the disease it is evident that dracontiasis will disappear from the coast towns when the provision of a properly-controlled water supply, obtained either from artesian wells or through pipes from some rapidly-flowing stream, permits the filling-in of the surface collections of rain water and the shallow wells upon which the natives now depend for their supplies. Care would have to be taken that any artificial reservoirs constructed were efficiently protected by their isolated situation from the possibilities of infection.

We have to adopt our prophylactic measures in the meanwhile, however, to the conditions as they now are in the towns, and as they will probably always remain in the inland villages. The simpler and less costly these are the likelier they are to be put into practice.

The native, more concerned with quantity than purity, takes his drinking water wherever it is most accessible—from rivers or rain tanks, from shallow wells, or the large ponds usually found at each village.

The question of the infectivity of these sources depends primarily on the presence of cyclops. It is said that cyclops does not occur in swiftly running waters, and this I found true of the Volta and the Sekum, the only rivers I had an opportunity of examining owing to the drought. It is noteworthy that in the village Oblogo, which depends solely on the latter stream for supplies, I could get no information of the occurrence of dracontiasis amongst the inhabitants. If, therefore, the scheme for providing Accra with this water becomes a reality it is to be expected that dracontiasis will disappear from the town. An examination of the rain tanks and the wells in and around Accra, Christiansborg, and Labadie was likewise negative. The reverse was the case with the village pools. Those at Akuse and Christiansborg were found to contain vast numbers of cyclops and other forms of crustacean life. In the latter village the evidence seemed irrefutable that the disease is endemic, and a small pond situated centrally, which supplied a proportion of the small population at least during the dry season, appeared the likely centre of infection. In cyclops obtained there I frequently found a nematode larva differing only from that of the guinea-worm in its greater size and the sharp chitinous tips of its triradiate tail. Probably it belongs to the genus *Cucullanus*, but it deserves mention as a possible source of error in the examination of suspected water.

At Akuse, numerous cyclops were found where the natives drew their drinking water, and where at another spot they could be seen washing.

In most of the villages of the plains I was able, while passing through, to procure cases of dracontiasis, and the histories were suggestive that the infection had been locally acquired. Unfortunately the ponds at most of these places had become dry, and, consequently, the presence of cyclops could not be determined.

The village pond seems to me undoubtedly the most likely source of the vast majority of infections. Attention must, therefore, be mainly directed, on the Gold Coast at least, to their protection. My negative results seem to show that the wells are relatively less important. The wells should be surrounded by a stone parapet of about 2 feet in height and the village pools stoutly fenced around in order to prevent the natives from bathing there or from wading into the water when filling their storage vessels. Each pool would have to be provided with a

sufficient number of "drawing" wells dug at a short distance from the pool and connected with it by underground pipes in such a way as to ensure a constant supply of water. The openings of these would be protected by a stone or cement wall. In this way by preventing water in contact with the legs of the drawers returning into the pool the chances of infection would be reduced nearly 90 per cent. The "drawing" wells would most likely be used freely by the natives, as less labour is involved in obtaining water by draw-bucket or pump than by collecting it with a calabash. Nor would the prevention of the use of the pools for washing prove as great a difficulty as might be supposed, for at several places the natives have already learnt to do this at a place apart from where the drinking water is drawn. At Accra, the filling of the large reservoir by a thunderstorm a few days before I left gave me the opportunity of observing that there those using the water for washing purposes carried it over the embankment to the lower ground. These precautions were, however, rendered unavailing, as far as dracontiasis was concerned, for those drawing the water for home use frequently entered it for some distance in order to secure a more copious supply than that obtainable at the margin.

If by these or other and more practical methods the infection of the open ponds in the villages could be prevented there is little doubt that a considerable diminution in the disease would soon result.

There still remain for careful investigation in relation to the prophylaxis of dracontiasis many details regarding the life of the intermediate host. We have still to determine more accurately the conditions under which it lives and multiplies in these tropical countries, what are its natural enemies, and upon what other forms of life it depends for its food supply; whether it can survive the drought of the summer, buried beneath the sun-caked mud, or if, when once a pool has dried, it must be restocked from another source. Lastly, if, by the addition of chemicals, we can destroy the cyclops in suspected waters without rendering these useless or dangerous to man.

No account of my investigations on the Gold Coast would be complete were I to leave unacknowledged the kindly interest with which Sir John P. Rodger and Major Bryan encouraged my work, the generous way in which the Principal Medical Officer and his deputy aided me with every facility the Medical Department could have provided, and the daily help and forbearance of Dr. Buée, who had charge of the Government hospital, and Dr. C. H. D. Ralph, the Medical Officer of Health for Accra.

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Enclosure 4.

SPIROCHAETOSIS OF MICE DUE TO SPIROCHAETA MURIS N.SP. IN THE BLOOD.

By C. M. WENYON, B.Sc., M.B., B.S., Protozoologist, London School of Tropical Medicine.

While studying the infection of *Trypanosoma dimorphon* in mice at the Pasteur Institute some five months ago, I noticed in one of the fresh blood preparations made from a brown mouse (A) infected with the trypanosomes, a small and very active spirochaete. At first I was of the opinion that its presence in the blood was due to

* Printed at pp. 40-41, above.

contamination from the skin, but, as it was constantly present and was found in blood taken from any part of the body, it was evident that it was parasitic in the blood.

Two mice (*B, C*) were inoculated subcutaneously with blood taken from this mouse. Mouse (*A*) died shortly afterwards of its trypanosome infection. About three hours after its death, preparations were made from many of the internal organs and the spirochaete was found to be present therein. At the same time other mice (*D, D'*) were inoculated with the juice of the liver and spleen. Of these mice, those which had been inoculated from the liver developed a trypanosome and spirochaete infection which proved fatal, while those inoculated from the spleen developed only a spirochaete infection. This fact is interesting as showing that in the spleen the trypanosomes are more readily destroyed than the spirochaetes after the death of the animal.

Returning to the mice (*B, C*) which were inoculated with the fresh blood of the original mouse (*A*) before it had died, it was found that there developed first a spirochaete infection and that a few days later trypanosomes appeared in the blood, thus giving rise to a mixed infection. Advantage was taken of this observation when I subsequently proceeded to isolate the spirochaetes.

Blood from one of these mice (*B, C*) was taken before the trypanosomes had appeared but after the spirochaetes had been found in its blood, and was inoculated subcutaneously in another mouse (*E*). This mouse developed a pure spirochaete infection. It was thus possible to isolate the spirochaete in two different ways, in the one case by inoculations with material from the spleen, in the other by inoculations with blood prior to the appearance of trypanosomes therein. In other words a pure spirochaete infection was successfully induced.

DESCRIPTION OF SPIROCHAETA MURIS.

In the fresh blood of the mice the spirochaete is found as a very active spiral. There is difficulty in seeing it clearly in the living condition owing to its active movements and small size. Moving along very rapidly, and turning on its long axis, it will suddenly come to rest and as suddenly dart off in an opposite direction. It seems a matter of indifference which end is directed forward. At times it spins rapidly about its central point, and at other times it rests one end against a red corpuscle or other body, while the free end vibrates rapidly to and fro. The spirals are permanent and the body fairly rigid though admitting of a certain amount of bending. Of course, owing to its small size, little of its structure could be made out in the fresh specimen, but all its movements seem to indicate the presence of flagella though these were never actually seen. There was no sign of an undulating membrane.

In blood preparations the spirochaetes remained active for hours after the trypanosomes had ceased to move. In stained preparations the spirochaete is seen as a uniformly staining spiral, the longer forms, however, show a clear unstained central spot (see Diagram, Nos. 8, 9). The ends are slightly tapering; there is no



Diagram 1. *Spirochaeta muris* n. sp. Different forms of the spirochaete. The circles represent the contours of red blood corpuscles. Giemsa stain. Drawn under Zeiss $\frac{1}{2}$ inch oil immersion.

sign of a nucleus or undulating membrane. As just mentioned, the larger forms have a clear spot at their centre, and in some of these the body of the spiral tapers towards this spot. In some cases two small spirals are attached end to end by an unstained region. These forms are evidently stages of transverse division. No indications of longitudinal division were seen nor any mode of reproduction other than the one just mentioned.

The number of turns of the spiral varies from six in the longest forms to two in the shortest. The length of the spirochaetes varies from 6 or 7 μ to 3 or 4 μ . The width is about 2 μ ¹.

¹ In specimens stained by Giemsa's method and examined in cedar oil without mounting in balsam. The spirochaete may be readily stained by any of the ordinary stains, Giemsa, fuchsin, methylene blue, &c.

The spirochaete was always seen in the spiral form; no other forms were found at any time.

INOCULATION EXPERIMENTS.

As mentioned above, it is possible to transmit the infection to mice by inoculating them with the blood of an infected animal. The smallest drop of blood is sufficient to give rise to a typical infection. There is always an incubation period of 5-6 days before the spirochaetes are found in the peripheral blood. At first very scanty, they increase in numbers during several days till about the tenth day, when they attain their maximum, and then their numbers begin to decline. At the height of the infection the numbers present are never very great, being at most five or six to a field (Zeiss D objective), but even this number is unusually large. The parasites disappear from the blood gradually in the course of two or three months, and, even when apparently absent, a prolonged search will generally reveal the presence of a few. I have a mouse now which was inoculated last March, over five months ago, and still at least one spirochaete may be found in each blood preparation. Judging from the results obtained by the inoculation of no less than 50 mice, these animals are all susceptible to infection by inoculation, the period of incubation not varying. I have never encountered a case of natural immunity.

The spirochaete infection does not appear to produce any abnormal condition in mice. In three very young mice which were inoculated the infection ran an ordinary course, and although two of the mice died after the intensity of the infection had commenced to decline, their death was probably due to other causes. The third mouse is still living (four months) and occasionally a spirochaete may be found in its blood.

One guinea-pig was inoculated with the whole of the blood of an infected mouse, but spirochaetes were never found in its blood.

An adult rat was also inoculated but it did not contract an infection. Three young rats were inoculated and two of these showed an infection after six days. The spirochaetes were never more numerous than in the blood of infected mice.

It appears therefore that the spirochaete produces in mice a definite infection having an incubation period of 5 to 6 days, reaching its maximum on about the tenth day and then gradually declining. Spirochaetes may be found even after 4 to 5 months.

The question of the origin of this spirochaete is one of interest. As stated above, it was first found in a brown mouse which had been infected with *Trypanosoma dimorphon*. Any relation with the trypanosome is of course disproved by the fact that it was quite easy to separate it and to obtain a pure infection. A parallel to this observation is that of Theiler who found spirochaetes and trypanosomes causing a mixed infection in cattle. Both my observation and that of Theiler give no support to the view that the two organisms are in any way connected with one another.

Mice fed on the blood of infected mice do not contract the infection.

Spirochaetes, identical with those found in the blood, were found in lice which infested the mice. These spirochaetes were few in number and showed no sign of active multiplication. Attempts at infecting mice by means of lice were not successful.

It has not been possible to cultivate the spirochaete on any of the ordinary media. Blood kept 5 days in the ice box and afterwards inoculated into mice gave rise to no infection.

THE ORIGIN OF THE SPIROCHAETA DISCUSSED.

A small spirochaete was seen by Borrel (1905) to occur in the juice of malignant growths of mice and he supposed it had migrated there from the intestine just as worms are liable to do in mice suffering from these growths. M. Borrel kindly permitted me to see some of his preparations and there appears to be no doubt that the two spirochaetes are identical. M. Mesnil, to whom I am much indebted for valuable advice and information, tells me that he has on several occasions noticed a small spirochaete in fresh blood preparations from mice, but he has not pursued the matter further.

In connection with my own observation it may be possible that the spirochaete was brought over with the strain of *T. dimorphon*, but the observations of Borrel, and the fact that the strain of *T. dimorphon* did not originally contain the spirochaete, indicate clearly enough that it is a separate and distinct mouse parasite. This is amply proved by the experiments here recorded and the apparently harmless character of the spirochaete infection.

The intestine of mice is generally crowded with spirochaetes, though none of these exactly resemble the one under discussion. In order to test the suggestion of Borrel that the spirochaetes had come from the intestine, mice were inoculated subcutaneously with mucus from the intestine of a mouse in which there were many active spirochaetes. The result of the inoculation was negative. No abscess formed, and no infection followed. A mouse in whose blood spirochaetes were present was killed and a small quantity of the contents of its intestine, which contained active spirochaetes, was inoculated subcutaneously into two mice. Here again no abscess formed and no infection followed. A control mouse inoculated with the blood of this mouse developed an infection. There is thus no evidence that the spirochaetes have originated from the intestine.

REGARDING OTHER SPIROCHAETAE.

In 1887, Vandyke Carter published a note on the occurrence of a minute *Spirillum* (*Sp. minor*) in the blood of the Indian rat (*Mus decumanus*). The parasite measures 5-9 μ in length, is very active, has no flagella, &c., possesses four to eight spiral turns and is slender and slightly pointed. There were at most only two to four spirilla visible in a field. The presence of the parasite in the blood did not apparently produce any pathological effects. Blood inoculated into a healthy rat and a monkey (*Macacus*) produced no infection. This spirochaete bears a close resemblance to the spirochaete of the mouse, but it is impossible to state whether the two are identical.

Lingard also describes a spirochaete ("an exceedingly minute *Spirillum*") as being present during the rainy season in the blood of Bandicoots (*Nesocia bandicota*). Infection may be conveyed by inoculation to rabbits and guinea-pigs. In rabbits the incubation period lasted about 20 days and the infection was paroxysmal, the animals dying in 16-37 days. In guinea-pigs the incubation period lasted about 24 days and the animals died on the day the spirochaetes appeared in the blood. The spirochaete is probably distinct from that of the mouse, but it is more difficult to form an opinion regarding Carter's spirochaete, as he did not try inoculation into mice, and, in fact, was unsuccessful in all attempts at transmission.

Balfour (1906) has described a small *Spirillum* as occurring in the intestinal ulcers of cases of trypanosomiasis in dogs and monkeys in the Soudan. This spirochaete, judging from Balfour's figure, bears some resemblance morphologically to the present one, but it is not known to occur in the blood.

Since the morphological characters of spirochaetes are not sufficient to establish the identity of any form it is necessary to rely on other characters, notably upon their behaviour in various hosts and their pathogenic or other action. As nothing is known of Carter's *Spirillum* of the rat, apart from its morphology, the spirochaete of the mouse must be considered to be new to science.

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-

APPENDIX VI.

THE ROYAL SOCIETY to COLONIAL OFFICE.

(Received June 22, 1906.)

SIR, Burlington House, London, W., June 22, 1906.
 I AM directed to forward, for the information of the Advisory Committee of the Tropical Diseases Research Fund, the enclosed progress report on the work done by aid of the grant of £500, placed at the disposal of the Tropical Diseases Committee of the Royal Society during the year 1905 for purposes of research into tropical diseases.

I am, &c.,
 ROBERT HARRISON.

Enclosure.

ROYAL SOCIETY.

Progress Report on the work done by the Tropical Diseases Committee of the Royal Society, by aid of the grant of £500 placed at the disposal of the Committee during the year 1905, for purposes of research into tropical diseases.

The whole of the grant has been expended upon investigations into sleeping sickness.

At the time when the Committee received intimation that a sum of money would be placed at their disposal from the Tropical Diseases Research Fund, Captain Greig was on his return home from Uganda, travelling by the Nile Valley in order to enquire into the reported existence of sleeping sickness there, and the work of the Commission on sleeping sickness in Uganda was being carried on at Entebbe by Lieutenant Tulloch, R.A.M.C., and Lieutenant Gray, R.A.M.C., on the lines inaugurated by Colonel Bruce and continued by Captain Greig.

Captain Greig's report on sleeping sickness in the Nile Valley, and the results of his long series of experiments at Entebbe, were published by His Majesty's Stationery Office, and are contained in a report issued in August last in continuation of the Committee's series of "Reports of the Sleeping Sickness Commission of the Royal Society." This report (No. VI.) also contains a note on "The distribution of the Tsetse Flies" by Mr. E. E. Austen, and a note on "The multiplication of the *Trypanosoma Gambiense* in the alimentary canal of *Glossina Palpalis*" by Lieutenants Tulloch and Gray.

The record of Lieutenants Tulloch and Gray's work subsequent to Captain Greig's departure has been embodied in a report which is now in the hands of the Committee for publication.

As already reported to the Secretary of State, Lieutenant Tulloch has recently been invalided home, suffering from Trypanosomiasis, contracted in the execution of his duty; and Lieutenant Gray, now in England on leave, is engaged in assisting Professor Minchin in working out the researches made by them at Entebbe.

In February, 1905, Professor Minchin was sent to Uganda on a special mission from the Committee, to work out the natural history of the trypanosome, and of the fly involved in carrying the disease. The expenses of this mission were defrayed partly by aid of the grant of £500 from the Tropical Diseases Research Fund, for the year 1905, and partly by a contribution of £500, made in March, 1905, by the Foreign Office towards the cost of this mission.

A preliminary report by Professor Minchin on "The anatomy of the Tsetse Fly" has been published in the proceedings of the Royal Society, and a preliminary

report on the work done by him in the course of his mission was presented to the Committee, and is submitted herewith.* The Committee await a full report from him of the result of his investigations.

Appended are copies* of

1. Reports of the Sleeping Sickness Commission of the Royal Society, No. VI., containing:—

- (a.) Continuation report on sleeping sickness in Uganda. By Captain E. D. W. Greig, I.M.S., and Lieutenant A. C. H. Gray, R.A.M.C. (Sleeping Sickness Commission).
- (b.) Report on Sleeping Sickness in the Nile Valley. By Captain E. D. W. Greig, I.M.S.
- (c.) The distribution of the Tsetse flies (with map). By E. E. Austen, F.Z.S.
- (d.) The multiplication of the *Trypanosoma Gambiense* in the alimentary canal of *Glossina Palpalis*. By Lieutenant A. C. H. Gray, R.A.M.C., and Lieutenant F. M. G. Tulloch, R.A.M.C.

2. Paper by Professor Minchin on "The anatomy of the Tsetse Fly."

3. Report by Professor E. A. Minchin upon the work done by him during his recent visit to Entebbe, Uganda, as Special Commissioner of the Tropical Diseases Commission of the Royal Society.

Referred to above.

* Not reprinted.

TROPICAL DISEASES RESEARCH FUND

R E P O R T

OF THE

ADVISORY COMMITTEE

FOR THE

TROPICAL DISEASES RESEARCH FUND

FOR THE YEAR 1907.

(For Report for 1906 see [Cd. 3306].)

Presented to both Houses of Parliament by Command of His Majesty.
March, 1908.



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1908.

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TROPICAL DISEASES RESEARCH FUND.

REPORT

OF THE

ADVISORY COMMITTEE

FOR THE

TROPICAL DISEASES RESEARCH FUND

For the Year 1907.

The Advisory Committee for the Tropical Diseases Research Fund was constituted by the Secretary of State for the Colonies in July, 1904, and was originally composed as follows:—

The Right Honourable Sir J. West Ridgeway, G.C.B., G.C.M.G., K.C.S.I.,
P.C. (Chairman).

Sir T. Barlow, Bart., M.D., K.C.V.O.

Sir M. Foster, K.C.B., F.R.S.

Sir T. Holderness, K.C.S.I.

Sir C. Lucas, K.C.M.G., C.B.

Sir P. Manson, M.D., K.C.M.G., F.R.S.

Sir R. Moor, K.C.M.G.

Surgeon-General A. M. Branfoot, C.I.E.

Mr. H. J. Read, C.M.G.

During the year the Committee suffered a great loss through the death of Sir M. Foster, who had rendered valuable service to the Colonies, not only by his work on the Advisory Committee but also by the active support given by him to measures for the improvement of the sanitary conditions of the Colonies from the time when the Royal Society, at Mr. Chamberlain's invitation, first took up the matter in connection with the investigation of malaria and blackwater fever.

In his place the Secretary of State, on the recommendation of the Royal Society, appointed Dr. J. Rose Bradford, F.R.S.

The revenue of the Tropical Diseases Research Fund for the year 1907 was made up as follows:—

Contribution from the Imperial Government	...	...	£500
Contribution from the Government of India	...	...	500
Contribution from the funds at the disposal of the Rhodes Trustees	...	...	200
Contributions from Colonial Governments	£1,875, in the following proportions:—		
Commonwealth of Australia	...	...	200
Gold Coast	...	...	200

Southern Nigeria	...	...	...	...	200
"	"	(Lagos)	...	...	150
Ceylon	...	...	...	...	100
Straits Settlements	...	...	...	...	100
Federated Malay States	...	...	...	...	100
Hong Kong	...	...	...	...	100
Trinidad	...	...	...	...	100
Mauritius	...	...	...	...	100
Fiji	...	...	...	...	100
Sierra Leone	...	...	...	...	100
Gambia	...	...	...	...	100
British Guiana	...	...	...	...	100
Grenada	...	...	...	...	50
Dominica (donation)	...	...	...	...	75

making in all a total of £3,075.

The expenditure of the year consisted of grants as follows:—

Grant to the Liverpool School of Tropical Medicine, £500; grant to the London School of Tropical Medicine, £1,083 6s. 8d.; grant to the University of London, £750; grant to Cambridge University, £100; making in all a total of £2,433 6s. 8d.

The grant (£500) to the Liverpool School was employed by the School for the payment of the salaries of a Lecturer in Economic Entomology and Parasitology and of a Lecturer in Tropical Medicine: both these Lecturers are required to devote their spare time to research.

The authorities of the School during the year brought before the notice of the Secretary of State and the Committee the urgent need of increasing the grant made from the fund. The grounds for the application were set out in a letter from the President, which is printed in the Appendix (p. 35). After full consideration the Secretary of State decided to ask the Treasury to increase the Imperial Grant to the Tropical Diseases Research Fund to £1,000 a year, and the Lords Commissioners of the Treasury having consented to do so, the Advisory Committee have agreed to allot £500 extra to the School, with effect from 1st of April, 1908, to be applied definitely to work in connection with sleeping sickness. A programme of the work to be done will be submitted for approval by the Committee before the grant is made.

Of the grant (£1,083 6s. 8d.) to the London School, the sum of £1,000 was devoted to the payment of the salary of a Teacher and Investigator of Protozoology and of the salary of a Teacher and Investigator of Helminthology, and to the provision of suitable apparatus, &c. The School also applied to the Advisory Committee for an increased grant in order to enable them to establish a post of Entomology in the School. The Committee decided to grant the sum of £1,000, to be spent over three years, for this purpose, on condition that the entomologist should undertake to make a collection of the noxious insects of the Colonies—a separate collection to be made of the noxious insects from each Colony, and the collections to be kept in readiness for reference by Colonial officials or doctors, and that he should be ready to advise on any questions referred to him by the Committee or by Colonial Governments. The London School accepted the grant on those conditions, and have appointed Colonel A. Alcock, I.M.S., C.I.E., F.R.S., to be Arthropodologist, with effect from the 1st of October. The balance of the grant, viz., £83 6s. 8d., represents a quarter's payment of this additional sum in respect of the period 1st October to 31st December, 1907.

The grant (£750) to the University of London was expended in paying the salary of the Professorship of Protozoology which was established in 1906 by means of a grant from the Tropical Diseases Research Fund.

The grant (£100) to the University of Cambridge was made on the advice of Dr. G. H. F. Nuttall, in order to establish a research Studentship in Medical Entomology. Recently a laboratory for investigation in protozoology, and in regard to blood-sucking insects, &c., has been inaugurated by Dr. Nuttall, in which facilities exist for the study of diseases due to protozoa in animals. The Student appointed will work under the supervision of Dr. Nuttall, and will devote part of his time to investigating some points of Colonial entomology.

No grant was made from the fund to the Royal Society during the year, since it was found possible to supply the sums required for the continuance of the

important researches as to sleeping sickness which are being carried on under the supervision of that Society from the funds of the Uganda Protectorate. But the Committee consulted the Society as to the utilisation of the Research Laboratory at Uganda, and the Society drew up a programme of research work which has been approved by the Committee and which will be carried into effect as soon as funds are available.

The Committee was also asked by the Secretary of State to advise him as to the practical measures to be adopted in connexion with existing conditions of sleeping sickness in Uganda. For this purpose a Sub-Committee was formed consisting of the medical members of the Committee and Mr. Read, who took evidence from the medical authorities of Uganda and other persons with local knowledge, and who reported to the Committee. The Committee finally decided to advise the Secretary of State that the measures to be adopted should include—

- (1) The segregation of all persons known to be infected with trypanosomes in camps which should be situated in places free from *Glossina*;
- (2) The removal of the apparently healthy from fly-infested areas to places where it is believed that no fly exists;
- (3) The clearing of such bush as would afford shelter for fly at all fords, ferries, landing places, and sources of water supplies, for a limited area, such cleared areas to be kept clear of bush and cultivated with low-growing crops which could not afford suitable shelter for the fly.

These recommendations were approved by Lord Elgin, and steps are now being taken to carry them into effect.

The Committee further considered the question which was before them in 1906 of the measures to be taken to encourage and systematize research work in the Colonies.

By their advice the Secretary of State has addressed a despatch, which is printed as Appendix VIII., to the Governors of those Colonies in which laboratories exist, suggesting the adoption of certain methods for preserving the results attained by research in those laboratories, and rendering them accessible to the successive officers in charge, and for securing that those officers shall engage themselves in investigations likely to be fruitful and to increase the knowledge of tropical diseases. The Committee are also ready from time to time to indicate lines of research suitable for any particular Colony. They trust that in this manner, without further expenditure being incurred, the value of the Colonial laboratories may be increased.

In this connexion it should be mentioned that arrangements have been made for the establishment at Lagos of a central research institution for all the British Administrations in West Africa. The staff will consist of a Director and an Assistant, who will be trained investigators, selected for special capacity in research work, and the cost of erecting the necessary buildings and of the maintenance of the laboratory to be created will be borne by the Colonies and Protectorates of Gambia, Sierra Leone, Gold Coast, Northern and Southern Nigeria.

The Committee have also further considered the proposal to extend the period of instruction at one or other of the Schools of tropical medicine undergone by all medical officers appointed to tropical Colonies. The Committee, however, while sympathising in principle with the desire of the Schools to afford a more complete training to medical officers, are satisfied that the proposals could not be accepted, partly on the ground that in some cases further training would not appreciably add to the value of the medical services rendered, but mainly because practical considerations render it impossible to allow a doctor a nine months' stay in this country before proceeding to the Colony to which he has been appointed.

The Committee append to their report a summary of the efforts made in the Colonies to combat malaria, and of the results of those efforts. This summary has been prepared from reports received from various Colonies in response to a request made by Lord Elgin in a circular despatch of 6th June, 1906—which is also printed—in connection with a question asked by Major Seely in the House of Commons. They also append the reports of the Lecturers at the Liverpool and London Schools of Tropical Medicine for the year November, 1906-October, 1907, the report of the Professor of Protozoology at the University of London for the year ended June 30th, 1907, a report from the Royal Society on the experimental treatment of trypanosomiasis, and reports from the several Colonial laboratories which have been sent in accordance with a request made by the Secretary of State

in December last. In these reports full details will be found of the work done and of the papers published in connection with the grants made by, or under the supervision of, the Board. The Committee are satisfied that the work done is of a high order of merit and fully justifies the continuance of the grants made.

Mr. Newstead, the Lecturer in Economic Entomology at the Liverpool Tropical School, has made a study of the question of the weevilling of stored grain, a matter of considerable economic importance to importers of corn, and on behalf of the Health Committee of the City of Liverpool has investigated the life-history of the common fly, with a view to devising measures to prevent its increase. Mr. Stephens, Lecturer in Tropical Medicine at Liverpool, has completed his enquiries into the anatomy of the proboscis of the *Stomoxys Calcitrans*, which turns out to be of a remarkably complicated structure. Mr. R. T. Leiper, Helminthologist at the London School, has published a study on the "America" Hookworm, which he has shown to be found in many other parts of the world besides the American continent, and has detected in pork received from America the dangerous parasite, *Trichinilla spiralis*, while during a six months' tour in Uganda he has collected material bearing on his subject.

Mr. C. M. Wenyon has, both in Egypt at the Wellcome Research Laboratories of the Gordon College at Khartoum, and in England, continued his researches on the intestinal amœbæ of animals.

The Government Bacteriologist in British Guiana has examined cases of acute anæmia and filariasis occurring in that Colony, and the Committee would draw attention to Dr. Castellani's interesting reports on yaws and elephantiasis in Ceylon. Trypanosomiasis in cattle and horses has been investigated in the Kuala Lumpur Institute. The Hong Kong Laboratory has made researches on a wide area, especially in regard to the introduction of plague by feeding.

WEST RIDGEWAY,
Chairman.

A. BERRIEDALE KEITH,
Secretary.

14th February, 1908.

APPENDIX I.

THE SECRETARY OF STATE TO THE GOVERNORS OF ALL COLONIES,
&c., NOT POSSESSING RESPONSIBLE GOVERNMENT AND THE HIGH
COMMISSIONER OF CYPRUS.

(Circular.)

SIR,

Downing Street, June 6, 1906.

I HAVE the honour to transmit to you the accompanying copy of a question asked in the House of Commons by Major Seely, requesting the grant of a return of the measures taken in the Crown Colonies and Protectorates to eradicate malarial fever, together with a copy of the reply returned.

2. I am anxious not to trouble your Government with the compilation of unnecessary statistics, and still less do I wish to hamper the practical work of combating malaria by requiring elaborate returns. I would desire, however, to meet, as far as possible, Major Seely's wishes. I recognise that the publication of annual or periodical reports showing what has, or has not, been done in the different Colonies and Protectorates to put into practice the preventives and remedies which have been abundantly tested by scientific experts is one method of ensuring steady progress. I propose therefore to adopt the following procedure.

3. It has been contemplated to issue annually a report of the work done by means of the funds subscribed by certain Colonies and Protectorates, and administered by the Advisory Board of the Tropical Disease Research Fund, which was constituted by my predecessor. I would suggest that the Advisory Board should utilise in their annual report, which would be issued early in each calendar year, any reports on the measures taken to eradicate malarial fever, yellow fever, and other mosquito-borne diseases which Colonial Governments may be able to supply. The report of the Advisory Board will be for the academic year, 1st October to 30th September, and it would therefore be sufficient if a section dealing with these measures could be inserted in the usual annual medical report of each Colony or Protectorate which is, or should be, always received at the Colonial Office before the autumn of the succeeding year.

4. This special report or section of a report would be supplementary to, and not in substitution for, the returns now included in the annual report. It should give a concise account of the nature and cost of all measures of the kind indicated which have been begun or were in progress during the period in question, whether by legislation, public works, education, sanitation, or otherwise, and it should, if practicable, give figures showing the comparative salubrity of different localities, and the varying rates of death or disease from malaria, &c., among the several classes of the community. Any really accurate and trustworthy figures as to the results of precautions taken against mosquito-borne infection should be of value.

I have, &c.,
ELGIN.

The Officer Administering
the Government of

Enclosure in Circular dated June 6, 1906.

HOUSE OF COMMONS.

Friday, May 4, 1906.

Major SEELY asked the Under-Secretary of State for the Colonies "whether he can grant a return showing the measures taken in the Crown Colonies and Protectorates to eradicate malarial fever, and the results as shown by the health statistics of the inhabitants."

Mr. CHURCHILL, in reply, said: "The Honourable Member's wish has been noted, and the Secretary of State is instructing the Advisory Board for the Tropical Diseases Research Fund to consider how it can best be met."

East Indies.

CEYLON.

THE GOVERNOR to THE SECRETARY OF STATE.

MY LORD, The Queen's House, Colombo, Ceylon, September 10, 1907.

I REGRET that Your Lordship's Circular despatch of 6th June, 1906, relative to the eradication of malarial fever has been so long unanswered.

2. Upon making enquiries as to the cause of the delay, I found that it was due to the provincial surgeons not having sent in returns on the subject called for by the Principal Civil Medical Officer, and to that officer not having taken steps to secure their being submitted with promptitude.

3. To avoid further delay I forward advanced proof of an addendum prepared by the Principal Civil Medical Officer, which he intends attaching to his Administration Report, in accordance with the proposal contained in paragraphs 3 and 4 of your despatch under reply. It deals with the measures taken to eradicate malarial fever in Ceylon, and gives the information required by the Advisory Board of the Tropical Diseases Research Fund.

4. As regards paragraphs 7 and 11 of the Principal Civil Medical Officer's report, I am informed that the employment of distributors was the reverse of satisfactory. In addition to Government Dispensaries, I am enquiring whether quinine powders should not also be obtainable free of cost at such places as police stations, Public Works Department lines, and headmen's houses, and whether it should not be made up in the form of powders in papers, on which is a notification in Singhalese that they are being given by the Government without any charge.

5. I have also informed the Principal Civil Medical Officer that in the interest of the natives and of the general well-being of the Colony I desire that a systematic crusade should be conducted against the anophele, and that measures which have proved so successful at Sierra Leone, Selangor, Ismailia, and elsewhere shall be carried out by his department in Ceylon. He will prepare a report on the whole subject with an estimate of the yearly expenditure required to effect this object. This report I will submit to Your Lordship, and shall hope to obtain your approval for the annual outlay which will be required for some time to come.

I have, &c.,

HENRY McCALLUM,

Governor, &c.

Enclosure.

MEASURES TAKEN TO ERADICATE MALARIAL FEVER IN CEYLON.

With reference to the Right Hon. the Secretary of States' Circular despatch of June 6, 1906, I have the honour to report that malarial fevers, although of a mild character, are very widely distributed throughout the whole of Ceylon; and this is not surprising when the character of the country is studied.

2. The high hills to the south of the middle of the Island attract a good deal of rain, in some places the rainfall is over 200 inches a year, and it may be said that on the west or east sides of these hills rain is more or less continuous for six months, that is, during the monsoons—the south-west monsoon brings the rain to the west side of the Island and north-east monsoon to the east side.

3. This large rainfall finds its way eventually to the sea, but after heavy falls the rivers overflow their banks and flood large areas of the surrounding country. The flat country of Ceylon is intersected near the coast with many canals and extensive lagoons; the cultivation of "paddy" under irrigation is largely carried on, and every favourable condition exists for the breeding of mosquitoes.

4. Without an enormous expenditure of money it would be impossible to deal with these watery areas, so as to reduce even in a small degree their danger as breeding places for mosquitoes; therefore nothing has been done by legislation or by public works towards the realization of that object.

The principal means to mitigate attacks of malarial fever among the inhabitants has been by education, sanitation, and the free distribution of quinine as a prophylactic.

5. *Education*.—Reprints in the vernacular of Sir Patrick Manson's diagrammatic pamphlet showing the rôle played by the mosquito in spreading malaria have been made and have been widely distributed to kachcheries, resthouses, and places of resort, in which they are exhibited in prominent positions.

A few popular lectures on the subject have been delivered in some of the larger towns. For the last four years a dozen medical officers of this Department have been through a short special course of instruction on malaria, lasting a fortnight, at the Ceylon Medical College.

For the last two years several native schoolmasters have been through a course of instruction on elementary hygiene with special reference to malaria, lasting three weeks, at the Ceylon Medical College.

Special pamphlets have been distributed to officers of the Irrigation and Survey Departments and to employés on the railway serving in malarious districts, and for the latter the General Manager of the Ceylon Railways has made stringent regulations on this subject, and in Colombo the Medical Officer of Health, Dr. W. Marshall Philip, has widely distributed a leaflet in three languages dealing with malaria and enteric fever.

6. *Sanitation*.—The tendency for many years has been towards improved sanitation in Ceylon; the progress is necessarily slow owing to the large expenditure of money required, which can never be obtained in sufficient amount. Improvements in the towns and villages is being carried out by the building of drains, filling up of hollows, the cutting down of trees and brushwood near dwellings, and by improved water supplies.

Medical officers in charge of districts have been directed to see that all rubbish is regularly burnt, that empty tins, cocoanut shells, and other articles likely to contain water are destroyed.

In Colombo a good deal has been done by the Medical Officer of Health towards eradicating malaria by the filling up of hollows in which water collected, and by the spraying of oil on the larger collections of water and by making the inhabitants keep their compounds clean.

7. *The Prophylactic Quinine Treatment*.—The most important measure undertaken by this Government was the free distribution of quinine as a prophylactic agent.

This was first introduced in the year 1904 among prisoners at Mahara jail, about seven miles from Colombo. A dose of 10 grains of quinine was administered to each prisoner on two successive days in each week, the results being encouraging; the experiment was tried in 1905 in a series of villages with a known malarial reputation in the North-Western Province. The population of this district was 466, of whom 232 took the quinine regularly and 234 did not do so. Cases of malarial fever occurred in the proportion of 15.51 per cent. in the protected subjects, and in the proportion of 65 per cent. in the unprotected. The year 1906 was one of the worst years for illness on record in Ceylon, and malaria was pandemic.

Orders were issued for the free distribution of quinine as a preventive of malaria over a wide area during the prevalence of the south-west and north-east monsoons, and for this purpose distributors were employed to issue the drug to the inhabitants; each distributor had an area to visit which took him a week at a time. He stayed at each place two consecutive days, and dosed those people whom he could persuade to take the remedy; but the native, although willing enough to take medicine when actually suffering from fever, cannot understand the use of taking it as a preventive when he is well. I am of the opinion that this distribution of quinine was very imperfectly carried out, the distributors were not men of education and they kept no records; it is true they disposed of a large amount of the drug, but whether it went to the people for whom it was intended is an open question. In all probability it was in many cases sold to those actually suffering from the disease.

The following summary is submitted of the provinces, districts, number of

villages, population, number of distributors, and number of inhabitants, to whom quinine was issued :—

PROPHYLACTIC TREATMENT OF QUININE DURING 1906.

Province.	Name of District.	No. of Villages visited.	Population.	No. of Distributors.	No. to whom Quinine was issued.
Sabaragamuwa	Ratnapura and Kegalla ...	195	59,519	24	4,011
Southern	Hambantota and Matara ...	45	245,692	7	5,674
North-Central	Anuradhapura	17	14,214	1	9,358
Central	Matale, &c.	209	39,807	9	10,730
Western	Negombo	126	62,027	10	5,910
North-Western	Kurunegala	214	8,691	—*	6,749
Eastern, Northern and Uva.	—	—	—	—	—
Total		806	429,950	51	42,432

* Headmen.

It is impossible to come to any conclusion as to the effect that this distribution had, for the year was the worst for malaria within memory, and there are no statistics to show how many of those developed fever who were supposed to have taken quinine, or the number of those who did not take the prophylactic and who contracted the disease.

8. The amount of quinine expended throughout Ceylon in 1906 was 87,555 ounces, and the cost, not including the wages of the distributors, was Rs. 73,299.

9. More satisfactory results were obtained in the distribution of quinine among school children by schoolmasters. The Director of Public Instruction supplied me with lists of his schools, and I divided them into schools affected by the south-west monsoon and those affected by the north-east monsoon. The Government dispensaries situated nearest to the schools were advised to issue quinine on the schoolmaster's requisitions, and the children were regularly dosed with the drug on two succeeding days weekly. This scheme has been carried out, I believe, very thoroughly, for it is much easier to employ a method of this kind among a community like a school or prison under discipline than among people who only voluntarily seek its aid. In some instances the parents objected to their children being dosed with medicine, but a little explanation generally sufficed to overcome this opposition.

10. In the nine provinces of the Island quinine was administered for periods of from six weeks to four months in 133 schools to 13,098 children, and the Director of Public Instruction reports that in many places where the administration of quinine was carried out the attendance of the children was better than in former years. On the other hand, in some districts there was no marked improvement in this respect.

11. It is evident that this prophylactic measure is quite successful in protecting a class of persons under discipline—*e.g.*, prisoners in jails and school children—but its use is doubtful when introduced among an unwilling native population who only take it voluntarily, and my belief is that greater good would result in spending the money on the drainage of swamps, oiling of large collections of water, the filling up of hollows, and the obliteration of borrow-pits along the lines of railway than in expenditure on quinine. In other words, it would be more profitable to attack the mosquito than the plasmodium.

I am in favour of the free distribution of quinine to persons under discipline and also to those more intelligent natives who seek the remedy at the various Government dispensaries, but I look with suspicion on the employment of ignorant distributors.

12. The Director of the Royal Botanic Gardens, on my suggestion, has given me a list of water-bearing plants, which during wet weather collect water in which mosquitoes breed :—

Bamboo stumps (worst of all perhaps);
Ravenala (traveller's tree),
Amomum,

Heliconia brasiliensis and many other scitamineæ (plants of plantain and ginger families),
Nepenthes (pitcher plant),
Bilbergias }
Karatas } Bromeliaceæ (pot and border plants).
Bromelias }
Æchmea }
Pandanus (screw pine),
Caraguata,
Dracæna Hookeriana and others,
 Spadices and leaf-sheaths of certain palms,

and it would be well if there were legislation to prohibit these plants from being grown in the neighbourhood of dwellings. The Director has also kindly undertaken as an experiment the treatment of growing paddy under the influence of petroleum, to see if the presence of the latter affects the paddy in a harmful manner, for it is proved that petroleum has no bad effect, paddy fields, which are a fruitful source of malaria-breeding mosquitoes, might be treated with petroleum and thus be rendered innocuous to the people who live in their neighbourhood. The results of this experiment are not yet available.

A. P.

MAURITIUS.

THE GOVERNOR to THE SECRETARY OF STATE.

MY LORD, Government House, Mauritius, November 29, 1906.

I HAVE the honour to state that the instructions contained in the third paragraph of your circular despatch of the 6th June, on the subject of Major Seely's question requesting the grant of a return of the measures taken in the Crown Colonies and Protectorates to eradicate malarial fever have been communicated to the medical authority, and will be duly observed.

2. I deem it advisable, however, to furnish your Lordship, in anticipation of the information which is to be annually supplied for the use of the Advisory Board of the Tropical Diseases Research Fund, with a report on the endeavours of this Government to counteract the ravages of the disease and the general position in that connection.

3. In the year 1901 a Committee was appointed to report on anti-malaria measures in Mauritius, which made an elaborate report in July, 1903. Certain funds were placed at its disposal, and it carried out various works in connection with the clearing of rivers and other places which formed the breeding ground for mosquitoes. Steps were also taken to investigate the haunts and habits of those insects, and to teach the people the important part played by mosquitoes in connection with malarial infection.

4. Full effect could not, however, be given to all the measures recommended, owing to financial considerations. A sum of Rs. 36,784.74 has been expended since 1901 on the works carried out.

5. Arrangements have also been made, and have been in effect for the last three years for the distribution of quinine to the poor.

6. In addition, however, to the sum above quoted, considerable expenditure has been incurred from ordinary annual votes on the estimates on several special sanitary works of an anti-malarial nature.

7. The three well-known means of combating malaria have been employed. The first, the mechanical one, which consists principally in shutting off the access of mosquitoes to dwelling houses by means of wire netting, has been tried with some measure of success at various public institutions.

8. The second means, the medical one, the prophylactic administration of quinine, has been tried extensively since July, 1903, when a number of quinine depôts were established in various parts of the Colony. They have gradually been increased in accordance with requirements, a sum of Rs. 2,500 a year being allowed for the purpose.

9. The third, and by far the most important way of checking malaria, is no doubt the execution of general sanitation works, *i.e.*, draining of marshes, canali-

zation of gutters, cleaning of rivers to allow water to run freely in their beds, suppression of stagnant pools, &c. A not inconsiderable amount of work has been done in this direction as above stated, especially in the districts of Pamplémousses, Moka, and Curepipe where extensive operations have been undertaken.

10. Appreciable results were obtained for some time in so far as the health of the riparian population is concerned. The satisfactory conditions have not, however, been fully maintained, owing to the inability of keeping up the good work done.

11. Financial and other considerations preclude the possibility of such works being carried out again and again by Government, and the question of throwing the responsibility for such maintenance on the districts concerned has been considered. The Medical Director has urged that a law should be passed to render compulsory the practice of *curage à vieux fonds et à vieux bords*, which would secure the proper upkeep of the works by the riparian owner without additional cost to the Treasury.

12. This question is intimately connected with the important subject of the river reserve laws of the Colony, and they are both at the present moment occupying the attention of the Government.

13. The work which has been done constitutes but a very small portion of all that is required to ensure success in an anti-malarial campaign, as sources of infection and nuisances of the same kind abound in almost every inhabited locality in this Island. The question is bound up with the financial one, and the resources of the Colony for the last two or three years have been very much strained.

14. With regard to statistics, the data at the disposal of the Medical Department will not allow of the malaria death rates being shown for each section of the community separately, as the Registrar-General's returns, upon which dependence must be made, only supply these figures with reference to the whole population of each sanitary area. Another factor which would render the information unreliable lies in the fact that all the deaths of the Island are not medically certificated, and the registration of many causes of death is fanciful, when not evidently erroneous.

15. Finally, the comparative healthiness of each locality, as revealed by our figures, will only be an approximation of the truth, as the death rate under existing conditions can only be calculated on the population of each area at the last census, which there is reason to believe has altered in many cases.

16. The whole of this important subject is receiving the care and attention of my advisers and myself, and in concluding these remarks I would assure your Lordship that our efforts will not be relaxed, whilst I would express the hope that given an era of equilibrium in the Colony's finances, which I venture to think has commenced, means may be found of gradually lessening the prevalence of malaria in the community, of eradicating the causes to which in part that prevalence is due, and of creating an effective and lasting improvement in the conditions of sanitation in the Island.

I have, &c.,
CAVENDISH BOYLE

STRAITS SETTLEMENTS.

MEDICAL REPORT, 1906.

(Extract.)

The following steps have been taken in the Straits Settlements for the eradication of malarial fever during the year 1906:—

- (1) Mosquito-proof wards erected at most of the native hospitals and where mosquito-proof wards have not been erected mosquito curtains supplied.
- (2) A course of lectures on elementary hygiene was given to the school teachers in Singapore.
- (3) Forty thousand dollars has been spent by the Public Works Department, in filling in swamps and building drains, &c.
- (4) The municipalities of Singapore, Penang, and Malacca are constantly carrying out improvements in drainage, &c.; but they unfortunately are unable to state the amount spent on this particular work as no separate record is kept.

- (5) Reclamations of swamps, other than Government property, is carried out by private individuals on the requisition of the Health Officer.

FEDERATED MALAY STATES.

MEDICAL REPORT, 1906.

Perak.

(Extract.)

(*Malaria.*) . . . The prophylactic measures taken against this disease during the year under review have not been of an extensive nature. In some of the bigger towns, such as Taiping and Ipoh, some ponds have been filled in and swamps drained. With our heavy rainfall the banishment of puddles and other suitable places for the breeding of mosquitoes is practically impossible; the only way of keeping malarial fever in check is with quinine, mosquito nets, and wire gauze. . . .

HONG KONG.

MEDICAL REPORT, 1906.

(Extract.)

. . . Since the year 1899, the attention of the Medical and Sanitary Departments has been specially directed towards the formation of breeding pools for mosquitoes, and although the work proceeded very slowly for a year or two, yet much has been done by the fumigation of the basements of European houses (with the consent of the occupants), by the training of nullahs, by the filling in of pools, by the subsoil drainage of swampy ground, and by the resumption here and there of a padi field which approached too closely to a police station or other European dwelling, to considerably lessen the facilities for the breeding of mosquitoes. . . .

West and East Africa.

GAMBIA.

THE GOVERNOR to THE SECRETARY OF STATE.

MY LORD, Government House, Bathurst, Gambia, July 23, 1906.

IN reply to your Lordship's circular despatch of the 6th ultimo, I have the honour to forward a report by Dr. Forde, the Senior Medical Officer, on the measures that have been taken in this Colony to eradicate malarial fever.

2. Dr. Forde has been most energetic in this work, and I submit that his efforts have, to a great extent, been successful, but, as he says, it is impossible to eradicate the mosquito where there are such large swamps as are to be found in St. Mary's Island on which Bathurst is situated.

3. The great thing, in my opinion, is to keep the anti-malarial sanitation work in full swing, and this is impressed on the medical officers and on the people of the place generally by me on all possible occasions. If this is not done, the condition of affairs will soon return to what it was previously to 1901.

4. I consider Bathurst an exceptionally clean town, but in the wet season it is liable to be flooded; fortunately, however, the soil is very porous, being principally sand, and water rarely stands for more than a few hours except perhaps in some of the very low-lying places. This year mosquitoes are very plentiful, more so than I ever knew them before, but this, no doubt, is due to the fact that the rain has been unusually heavy. They are, however, principally *culex*, not *anopheles*.

I have, &c.,

GEORGE C. DENTON,

Governor

Enclosure.

SIR, Medical Office, Bathurst, West Africa, July 16, 1906.

I HAVE the honour to forward the following report on the measures taken in this town to eradicate malarial fever, two tables being added showing the results as affecting the health of the inhabitants for the years 1900 to 1905 inclusive.

For some years prior to 1901, a certain amount of anti-mosquito sanitation had been practised, but owing to the general indifference on the subject shown by both the home and local authorities, neither sufficient money nor interest could be raised to carry out the work with any degree of success.

In 1901, the Liverpool School of Tropical Medicine sent out the late Dr. Dutton to study the question of the reduction and prevention of malaria in Bathurst, and as the result of his researches together with his convincing arguments as to its advisability and advantages to the general health of the town, the new sanitation was taken up in earnest.

His Excellency Sir George Denton, K.C.M.G., &c., with his usual interest for the welfare of the community, immediately acted upon Dr. Dutton's recommendations, and there was voted in Council a special grant of £250 per annum to be added to the Board of Health's estimates for the purpose of carrying out the special measures necessary for the destruction and the prevention of the propagation of mosquitoes. The existing sanitary laws were also amended to meet the new condition of things, and enable the Sanitary Board to perform the work as completely as possible.

The following were the measures adopted for the performance of this anti-malarial sanitation:—

I. A special gang of ten labourers were engaged with an Assistant Sanitary Inspector whose duties were to fill up all stagnant pools, hollows, and depressions likely to act as breeding places for mosquitoes, cleaning the grass water-courses in the town so as to prevent the formation of stagnant pools in them, and to keep down the overgrowth of grass and weeds.

II. The Inspector of Nuisances was instructed in the recognition and detection of mosquito larvæ in water, and makes daily inspections of premises and gardens to see that water receptacles, such as wells, tanks, casks, and tubs are not allowed to act as breeding places, the results of such inspection being entered in his diary for the information of the Chairman of the Board of Health.

III. The collection of all useless articles likely to act as breeding places for mosquitoes, such as old tins, broken bottles, calabashes, &c. These are regularly collected and removed by the Board of Health carts, and are buried in the waste lands around the town.

IV. The covering of all wells, public and private, and water receptacles has been enforced.

V. In the rainy season all unavoidable collections of flood water are periodically disinfected with kerosene oil in order to prevent them becoming breeding centres for mosquitoes.

VI. Pamphlets and rules dealing with the prevention of mosquitoes, avoiding being bitten by them, the proper use of the mosquito net, and the regular taking of quinine as a prophylactic, are now and then issued, particularly to the schools, it being very necessary to remind the public occasionally on these points.

VII. All boats lying on the Wellington Street beach are periodically examined for the purpose of preventing them holding stagnant water, and special regulations have been formulated compelling owners of canoes, boats, and cutters to so place them when beached that they will not retain water, and so act as breeding places for mosquitoes, and become a nuisance in other ways.

These measures are still being regularly carried out.

The following tables show the results after a little over four years of anti-malarial sanitation which was begun towards the end of 1901. I have added the year 1900 as a comparison.

Table 1 shows a steady decrease in the general death rate. Table 2, which refers to Europeans only, shows a marked falling off in the number of malarial fever cases.

TABLE 1.

Showing the total deaths from diseases at all ages, and under 5 years, and the rate of each per 1,000 of the population of Bathurst.

	Years.	Total Deaths.	Rate per 1,000.	Deaths under 5 years.	Rate per 1,000.
Anti-malarial Sanitation.	1900	350	39·77	120	13·75
	1901	340	38·63	137	15·56
	1902	266	30·22	112	12·72
	1903	315	35·79	130	14·77
	1904	303	34·40	124	14·07
	1905	299	33·95	117	13·29

TABLE 2.

Showing the number of cases of illness and invalidings among Europeans during the past six years, and the number resident in the Colony for each year.

					1900.	Anti-malarial Sanitation.				
						1901.	1902.	1903.	1904.	1905.
Number of Europeans resident	...	...			71	88	98	105	100	114
„ „ treated	...	...			90	89	26	47	42	43
„ „ died	...	...	...		9	4	2	2	—	2
„ „ invalided	...	...			—	3	2	2	—	1
Malarial fever cases	...	...	...		45	54	11	15	24	22

The town of Bathurst, partially surrounded and skirted by creeks and swamps as it is, is most unfortunately situated, so far as the total annihilation of mosquitoes is concerned; otherwise, with its long dry season, it would have been possible to reduce the mosquito pest to almost zero, but as it is, almost every wind that blows towards the town brings its swarms of that troublesome insect, and all we can hope for at present is the abolition of their artificial breeding grounds in and around our dwellings by the constant application of the few simple sanitary precautions which are now in full operation, and in which we are endeavouring to enlist the energy and intelligence of the public in general.

I have, &c.,

R. M. FORDE,
Senior Medical Officer.

GAMBIA.

MEDICAL REPORT, 1906.

(Extract.)

... The usual scavenging was carried out by twenty permanent labourers, under an Inspector of Nuisances and an Assistant Inspector; the former carrying out house to house inspection regularly for the detection of unnecessary accumulations of slop water, broken bottles, old tins, &c., and other articles likely to act as breeding places for mosquitoes.

During the rainy season thirty extra men were employed for the clearing of the water-courses and cutting down of the high grass and weeds that so rapidly spring up over the town at this time of the year.

SIERRA LEONE.

REPORT ON MEASURES TAKEN TO ERADICATE MALARIAL FEVER, &c., BY LEGISLATION, PUBLIC WORKS, EDUCATION, AND SANITATION DURING THE YEAR 1906 IN THE COLONY OF SIERRA LEONE.

A. Sanitation of Freetown.—The Sanitary Authority of Freetown is the City Council. Very considerable energy has been shown in the effort to make progress in sanitation, so far as the limited resources at its command will allow. Little in the direction of new works can be expected from it, unassisted.

2. The maintenance and repair of streets, bridges, drains, &c., are undertaken by the Government, and £2,235 was expended on this work in 1906.

3. A good and liberal supply of water has been maintained from the reservoir, delivered through stand pipes at convenient places. Wells are consequently falling into disuse, and they will probably be almost altogether abandoned in the near future, when it may be possible to effect complete closure of most, if not all, of them, without entailing hardship on any one.

4. No extensive systematic drainage works were carried out in Freetown during the year 1906, but the drains already existing have been maintained in a fair degree of efficiency. The canalisation in parts of some of the streams which traverse the town was carried out by the Government, and with fairly satisfactory result till damage, and frequently recurring blocking by sand and stone carried down by heavy rains, impaired the efficiency of these concrete canals.

5. House to house visitation, the frequent inspection of yards, courts, cess-pits, latrines, &c., was carried out by a staff of Inspectors under the direction of the Medical Officer of Health. These Inspectors are largely recruited from the police force. Notices were issued on householders, owners, occupiers, &c., to abate nuisances, clean premises, remove high grass, weeds, bottles, tins, pots, &c., from yards and pathways adjoining, and summons followed failure to comply.

6. Dust-bins and dumping grounds are provided for the deposit of rubbish, and from these the Sanitary Department of the City Council removes it to pits; in which it is as far as possible burnt, and to "shoots" for discharge into the sea. It has been found that heavy rains tend to interfere with the usefulness of these pits, directly and indirectly, by stimulating rapid growth of vegetation, which, if not disposed of soon after it has been cut, rapidly decomposes, and the combustion of it while fresh and green is slow, and attended by objectionable smoke.

7. Part of the cost of upkeep of Hill "Station" (the sanitary arrangements alone costing £245 per annum), and maintenance of the Mountain Railway may fairly be reckoned as expense incurred in preventing malaria amongst European officials; part of the expense in connection with the housing of most of the European staff of the railway at Cline town was incurred with the same object. Mosquito-proof wire gauze was largely used in the construction of these quarters.

8. Instruction was given by Dr. Hood, Acting Principal Medical Officer, in hygiene, to the teachers, who instruct pupils in the schools in the elements of the science.

9. Out of a total revenue of £6,913, the City Council spent no less than £1,978 through the Sanitary Department in 1906.

B. The Sanitation of Sherbro has been of late placed in the hands of the Municipal Council of that town, and improvement is already reported in its sanitary condition.

C. Sanitary Inspection of Towns in the Protectorate was undertaken by the District and Assistant District Commissioners, and on their reports prizes were awarded to those chiefs who showed most energy and best results in this direction during the year. The amount expended on these prizes was £30.

D. The death rate for Freetown in 1906 was computed at 32.02 per thousand, and compares favourably with the record for the previous five years.

The death-rate from climatic causes amongst Europeans resident in Freetown

(estimated at 300) was 1 per cent. The official sick-rate (average number of days on the sick list) of all officials was 7·46; in 1905, 7·08; in 1904, 7·74.

For native officials the figures are 7·36 ... 6·77 ... 7·84.

For European officials the figures are 7·53 ... 7·28 ... 7·53.

The number of officials on the sick list was 308 ... 366 ... 372.

The number of native officials on the sick list was 240 ... 284 ... 302.

The number of European officials on the sick list was 68 ... 82 ... 70.

R. H. KENNAN,
Acting Principal Medical Officer.

July 31, 1907.

NORTHERN NIGERIA.

MEDICAL REPORT, 1906.

(Extract.)

. . . All practical means for the eradication of malaria are taken as part of the routine sanitary work. . . .

SOUTHERN NIGERIA.

(A.)

THE GOVERNOR to THE SECRETARY OF STATE.

Government House, Lagos,

MY LORD,

Southern Nigeria, December 6, 1907.

THE subject of sanitary work in Lagos is so frequently the subject of discussion that I think it desirable to forward to your Lordship a copy of a report* by the Director of Public Works on swamp reclamation work carried out between July, 1904, and July of the present year.

2. The sums recorded as spent on swamp reclamation since 1900 have been as follows:—

—				Approved in Annual Estimates.	Supplementary Expenditure.	Total Expenditure.
				£	£	£
1900	...	...	...	2,000	682	2,682
1901	...	...	...	2,750	877	3,627
1902	...	...	...	4,500	—	3,144
1903	...	...	...	5,000	2,677	7,677
1904	...	...	...	4,250	4,378	8,628
1905	...	...	...	4,750	1,822	6,572
1906	...	...	...	4,000	511	4,511
1907 to 30th November, 1907.				3,000	500	3,022
Pontoon Pump Dredger				3,300	(unspent 30th November, 1907).	3,300
1908	...	...	...	5,000 (proposed).	—	—
						£43,163

Making a total of money spent up to the present date of £43,163.

3. I fear that paragraphs 26 and 28 taken together are somewhat misleading. I gathered from these paragraphs that £15,000 would nearly finish the swamp reclamation in the half of the island to the west of the MacGregor Canal (which is the half in which the town of Lagos is situated), but it will be seen that we have already spent over £40,000 and it will probably take at least another £40,000 to complete the work. The condition of the town has, however, been immensely improved and the noisome swamps that previously existed in the southern half have been entirely reclaimed. The portion not yet dealt with is the northern half, which lies at the back of the island and is chiefly inhabited by the poorest classes of the population.

* Not reprinted.

4. With reference to paragraph 31 I would remark that the amount devoted this year to swamp reclamation should include the cost of the pontoon pump dredger, costing £3,300, which was specially bought for swamp reclamation work. It has up to the present been employed in filling the swamp adjacent to the signal station and its economical working will be improved by the supply of condensing engines which have already been ordered and which are expected to arrive shortly.

5. The amount recovered by Government by the sale of reclaimed land has been £2,750 for a portion of the Eiegbata reclamation. The rest of the reclaimed areas have been retained as open spaces.

I have, &c.,
W. EGERTON,
Governor.

SOUTHERN NIGERIA.

(B.)

THE DEPUTY GOVERNOR to THE SECRETARY OF STATE.

Government House, Lagos, Southern Nigeria,

MY LORD,

December 9, 1907.

In compliance with the instructions contained in your Lordship's circular despatch, dated June 6, 1906, I have the honour to enclose herewith reports from the Director of Public Works and the Principal Medical Officer showing the measures taken in this Colony to eradicate malarial fever and the results attained as shown by the health statistics of the European residents.

2. These reports should be read together with my despatch of 6th instant, on swamp reclamation and drainage work carried out in Lagos.

3. I am glad to be able to state that the mosquito-proofing of houses, or complete rooms, is gradually being less objected to. In addition to Dr. Strachan's quarters I would observe that my quarters in Government House, including the office in which I work, are completely mosquito-proofed. Government House now is almost quite free from mosquitoes. When I arrived here in September, 1904, it still bore the character of being one of the worst houses in Lagos for this pest.

I have, &c.,
J. J. THORBURN,
Deputy Governor.

Enclosure 1.

SIR,

Public Works Department, Lagos, October 24, 1907.

I HAVE the honour to forward herewith brief memorandum on the subject of anti-malarial work in Southern Nigeria, including Lagos, during the years 1900 to 1906 inclusive.

2. The submission of this information has been delayed owing to the extraction from the file of Statement of Expenditure from the Provincial Engineer, Eastern Province, which was submitted to you under cover of my letter of 19th June last. This necessitated a reference to Calabar, and a copy of that Statement has now been replaced in the file.

3. Neither of the Statements prepared by the Provincial Engineers, Eastern and Central Provinces, coincide with that furnished by the Financial Department, but in the attached Memorandum the figures from the latter have been adopted.

4. Further information on this subject will be found in your 4441/06, and in the files containing my reports on "Swamp Reclamation" and "Sewage Disposal."

I have, &c.,
C. V. BELLAMY,
Director of Public Works.

The Honourable
The Colonial Secretary,
Lagos.

ANTI-MALARIAL WORK.

MEMORANDUM BY DIRECTOR OF PUBLIC WORKS, SOUTHERN NIGERIA.

1. The measures adopted during the years 1900 to 1906 in connection with the suppression of malaria include principally:—

- (1) Swamp reclamation and filling.
- (2) Drainage of swamps.
- (3) Surface drainage other than drainage of swamps.
- (4) Sanitary drainage.
- (5) Reclamation and protection of foreshores and beaches.
- (6) Improvements, &c., to water supplies.
- (7) Scavenging and town conservancy.
- (8) Improvements to washing grounds.
- (9) Construction of roads.
- (10) Street improvements and acquisition of properties for widening streets.
- (11) New bridges and culverts.
- (12) Mosquito proofing.
- (13) Removal of night soil.

Expenditure.

2. Statements of expenditure prepared in detail are attached hereto, summarized they give the following results:—

Expenditure on Anti-Malarial Work.

Lagos (or Western Province, Southern Nigeria) 1900-1906...	£81,702	11	2
Southern Nigeria Protectorate (or Eastern and Central Provinces of Southern Nigeria) 1900-1906	27,367	8	9
Total	£109,069	19	11

Distribution of Expenditure.

3. In the case of the Western Province the expenditure has been almost entirely confined to the town of Lagos or its immediate neighbourhood whereas in the case of the Eastern and Central Provinces, the work has been distributed over a number of localities. This may be explained by the difference in the physical characteristics of the two countries, and to the greater necessity in the latter for reclamation, drainage, and other similar works, so many of the stations in the former Southern Nigeria Protectorate being, through the exigencies of trade, located in swampy neighbourhoods.

Reclamation.

4. Of the precise nature of the work done in each locality, the records are not very clear, but in the cases of stations on the Niger or in the Delta, it may be briefly described as the operation of converting the uninhabitable into the habitable, of reclaiming ground foot by foot from the swamp, river, sea, or forest until a sufficiently large space has been recovered to build a habitation upon. Year by year this space has been extended according to the necessities of the case or the dictates of sanitary science, and the effort of clearing the forest and admitting sunlight and a free circulation of air over the surface of the ground has of itself improved by natural means the health of such places while the cutting of drains for the release of storm water or the construction of embankments for the exclusion of the same have lowered the subsoil water, and still further added to these improvements.

Sanitary Drainage.

5. In settled stations also efforts to remove all accumulations of water in the immediate neighbourhood of dwelling houses arising from whatever cause, whether discharged from the bath or during the process of cleansing the utensils employed in the kitchen, or for domestic purposes have been systematically pursued with satisfactory results.

Water Supply.

6. In situations where well water is not to be depended upon except for ablutionary purposes, and where water for drinking and cooking has to be collected from

roofs and stores in rain-water tanks, measures have been taken to protect the latter and prevent them, as so frequently happens when simple precautions are neglected, from becoming fertile breeding grounds for mosquitoes, and the adoption of special precautionary measures to this end have been persisted in wherever the necessity has arisen. The obstacles prevailing are, however, numerous, and not the least of these is the carelessness and destructiveness of native servants who are, for the most part, imbued with an abnormal capacity for injuring the fittings of tanks specially designed and provided for the protection of their masters and themselves from the ravages of the mosquito. The devices which have been produced for the exclusion of the mosquito from the tanks and for resisting the depredations of servants have been numerous in the past, but the arrangements which do not attain this object must inevitably fall very far short of perfection. The town of Lagos is still dependent for its water supply on that derived from wells or collecting tanks, but the quality of the former is usually satisfactory, and the quantity copious.

Water Spring.

7. Wherever it is possible to procure a source of water secured from present or future contamination efforts to develop such sources of supply should be persisted in. Conspicuous among the cases of this description is that of Calabar, which is supplied from a natural and bountiful spring of water not more than a mile or so from Government Hill. Nevertheless, it has now become an axiom of tropical sanitation that "a water supply should not be brought into a town unless efficient arrangements have been made for its removal immediately it has served its purpose." This important factor is only too frequently neglected, but fortunately for Calabar the hilly nature of the Government settlement greatly assists in the solution of this difficulty. Practically the whole of the European community residing in Calabar now shares in the advantage of a constant supply of water laid on to all premises.

Collection of Refuse.

8. In all stations, arrangements exist for the proper collection and removal of refuse and night soil. At out-stations this is performed generally by gangs of prisoners, and the rubbish disposed of by either burying or burning.

Lagos Sanitation.

9. In Lagos, however, with a nominal population of about 50,000, this task is a larger undertaking and is performed by contract. Town refuse and scavengings are collected in orderly bins and removed daily by the contractor by canoes and discharged into the lagoon at a sufficient distance from the town to secure its disposal away from any dwelling houses. Night soil is similarly collected from latrines and privies by a contractor in the case of Government establishments or by private enterprise in other cases. It is eventually dejected into the lagoon, but a more comprehensive and efficient means of disposal is under the consideration of the Government and its introduction has already been brought about, during the present year, in a limited area of the town. This has formed the subject of a special report to Government.

Washing Grounds.

10. The process of washing domestic fabrics or wearing apparel calls for special provision in regard to water supply and drainage, and wherever the operation is conducted on a large scale, arrangements require to be made to prevent accumulations of stagnant water. This is usually accomplished by means of a concreted surface discharging into drains to lead away the foul water into the lagoon, river, or other recognised channel of disposal.

Roads.

11. The construction and proper maintenance of roads is an important factor in anti-malarial work because the formation of macadamized or other properly surfaced roads implies the construction of drains primarily for the protection of the same, but also beneficial in the removal of surface water or the drainage of marshy areas. The progress in this direction is particularly marked in the towns of Lagos and Calabar, and the authorities at all out-stations are pursuing the same policy.

Street Improvements.

12. In all towns and settlements a stricter watch is being kept to protect the public thoroughfares from encroachments, and whenever the case demands or funds permit, private property is acquired and removed for the widening of streets to encourage the free circulation of air.

Bridges and Culverts.

13. Properly constructed bridges and culverts tend also to reduce the number of localities where mosquitoes are likely to breed, and the number of such structures is increasing year by year. In Lagos and Calabar, where such works are most needed, the results have been striking and satisfactory, and in both cases means are adopted for the periodical cleaning of the same.

Mosquito Proofing.

14. The employment of means for the exclusion of mosquito from dwelling houses is, so far as this Colony is concerned, a comparative innovation, but already the majority of quarters in localities where the mosquito is most aggressive are protected either wholly or in part by wire gauze. Its introduction in many cases has been opposed by individual prejudice, which is not the least of the causes which have prevented its general adoption. It may safely be said, however, that at the present time no dwelling house is erected without some provision being made where the occupants can find refuge from the pest.

C. V. BELLAMY,
Director, Public Works.

October 24, 1907.

Enclosure 2.

ANTI-MALARIAL WORK IN SOUTHERN NIGERIA.

1. *Quinine.*

1. Quinine is issued free to all Government officials, European and native, who will take it. The system was commenced in 1901, in the Western Province and during 1905 990,258 grains, and in 1906 1,087,100 grains were issued.

2. The native population has been encouraged, by lectures and teaching, to take quinine, and to go to the dispensaries for it; and especially to treat the infants and children.

3. A quinine ration is issued weekly to:—

(a) The prisoners in the jails; and

(b) All police and West African Frontier Force soldiers, who will take it. Many of these avail themselves of the privilege, and the results have been most satisfactory (*vide* end of paragraph 7).

2. *Reclamation of Swamps.*

Swamp land reclamation is being steadily carried out. This will be one of the most valuable means of reducing malaria in this country, when thoroughly carried out. In swamps mosquitoes breed mainly, if not solely, at the margin of the swamp land. It is clear that, if in reclaiming swamp surface depressions are left, and thorough drainage not provided, the rise of the water level, which is often at the surface of the ground in the rainy season, causes all such depressions to become pools, in which the mosquito larvæ breed almost as freely as in the former swamp.

The improvement in Lagos from reclamation during the past few years is most marked. One very large area, which three years ago was foetid mangrove swamp-land, is now a level, grass-grown plain, where golf links have been established. Other similar areas have been filled in, and become a valuable asset, as well as a vast sanitary and anti-malarial improvement. Swamp reclamation has been largely carried out in the Eastern and Central Provinces. At Calabar the cutting of a canoe canal has materially reduced the amount of moisture found in the swampy ground. In certain districts the circumstances are such that little can be effected in the direction of reclamation, but in these, of which Abo, in the Central Province, may be cited as an instance, the constant flow of water is destructive of mosquito

larvæ, and it is notable that at a station more subject to floods perhaps than any other, the health is surprisingly good, and fever among Europeans is quite exceptional. At Bende, in the Eastern Province, the problem presented by a large pond, which is formed during the rains, is solved to some extent by allowing a free outflow through artificial channels. At Benin City a most useful work has been accomplished entirely by voluntary and prison labour, where a hole near to the site of the King's compound measuring some 80 yards across and eight yards in depth has been entirely filled in. At Brass, in the Eastern Province, the cutting of the large drains has materially relieved the excess of moisture.

3. *Use of Oil to Standing Water.*

Kerosene oil is used on the surface of stagnant water in places which cannot be filled or drained. It has been found particularly useful in the Eastern and Central Provinces for the purpose of preventing mosquito breeding in the temporary stagnant pools and ponds left by the heavy tornado rains. It is also an excellent protection to tank water where gauze is not available, and at Afikpo its constant use has been found to be as reliable a safeguard as gauze. Larvicide has been employed with good effect in places unsuited for oil.

4. *Treatment of Wells, Tanks, and Eave-gutters.*

The complete and perfect covering of wells with the attachment of pumps has been strenuously advocated, as open wells form dangerous breeding-places for mosquitoes. This particular precaution has not been so far widely extended, but there is good ground for hoping that it will be in the future. The mosquito-proofing of tanks, an important essential, is also constantly advocated, and has been carried out fairly well in Lagos Town in Government Buildings; unfortunately, it is not in universal use even in these. The more important stations in the provinces have already adopted this measure, and it is rapidly being extended to bush stations. Attention to the eave-gutters of houses, which necessarily exist for the collection and storage of tank-water has been constantly urged. Defective gutters, which unfortunately abound, form one of the greatest difficulties in fighting the spread of mosquitoes which breed in these in profusion. This tends to neutralise the good done by destroying the other breeding-places in compounds (*vide* paragraph 5). In Calabar the excellent water-supply has made it possible to abolish eave-gutters, and, consequently, this source of danger is obviated.

5. *Destruction of Mosquito-breeding Places.*

All that is possible is done by teaching, example, and the vigilance of sanitary inspectors, to clear compounds of old tins, broken china, calabashes, neglected water pots, and the other various collectors of water in which the larvæ breed. Good work has been done in this direction, and in some stations house-to-house lectures by district medical officers have been of good effect.

There can be no doubt that the number of mosquitoes has been greatly reduced by the precautionary measures which have taken the form of bush clearing. Care is now taken at all stations to keep in check the growth of grass in the vicinity of bungalows, and bush clearing has been carried on practically at every station in the Colony and Protectorate. The work has been by no means confined to new stations, and it may be mentioned that at Brass an area five hundred yards long and thirty yards wide has been cleared of bush and timber, and at Egwanga there are now 200 acres of clear grass country. At Asaba the land adjoining the Government Buildings is now quite clear of bush, as is also the entire reservation at Sapele. Indeed, reports from the stations show almost universally the importance attached by officers to this work.

Trees and herbage affording shelter to adult mosquitoes are judiciously thinned and removed. The bamboo, though ornamental, is very dangerous, as, not only do the adult insects shelter in the foliage, but the larvæ breed freely in the broken joints of the stems, which hold water for a long time after each shower of rain. The removal, therefore, of bamboos growing near dwellings has been advocated, and in Lagos Town some have been removed with benefit to the neighbouring houses.

6. *Use of Mosquito-proof Houses or Rooms strongly advocated.*

Mosquito-proof houses are perhaps the most potent aid against malaria in this Colony in view of the great difficulty, if not impossibility, of entirely exterminating mosquitoes, and the danger from the malaria poison existing in the native population. Their use is constantly urged in Lagos, but with little effect. Even in those Government quarters where a mosquito-proof room has been provided, it is but little used by the occupants, who complain either of the increased heat or of the inconvenience of its situation. There is some basis for both these objections in certain instances. But if malaria infection is to be avoided, it is imperative that at least the rooms used in the evening hours should be mosquito-proof, that is to say, the dining and sitting rooms. Unless this is done a mosquito-proof bedroom, or other room which is occupied in the evening, is practically useless, since infection takes place most frequently during dinner and when sitting afterwards, before going to bed. The mosquito net properly used affords enough protection in the bedroom, when it is not possible to mosquito-proof all the house. If economy prevent full mosquito-proofing of a house, it is far better to use wire-gauze for the dining and sitting rooms than for a bedroom.

It is submitted that the gain in improved health and working power must compensate amply for any outlay. The heat complained of in mosquito-proof rooms can be mitigated by means of punkahs and fans.

The Principal Medical Officer states as follows:—"My present house is, I believe, the only mosquito-proof house in Lagos. During a year's occupation I have not been infected. For two years I lived in what is perhaps the hottest house in Lagos—which I had made mosquito-proof—and was never infected with malaria. But it is obvious that while one is thus protected in such a house, every evening spent in another house permits of infection; hence for complete protection of all persons, every house should be treated with gauze."

7. Statistics are, unfortunately, not available as to the Eastern and Central Provinces, but the following figures as to Lagos with explanatory remarks by the Principal Medical Officer will be of interest. In 1900-1901 the European population for Lagos and Ebute Metta (including shipping) was 233. In February, 1906, it was at least 400 and was then increasing.

(1) Deaths among European officials from malarial fever and blackwater fever:—

—					Malarial Fever.	Blackwater Fever.
1897	...	...	...	...	2	—
1898	...	...	...	...	2	—
1899	...	...	...	...	4	—
1900	...	...	...	...	5	—

Anti-mosquito work started, and quinine for prophylaxis issued free to, and its use urged on, officials more emphasized during the latter part of 1900.

—					Malarial Fever.	Blackwater Fever.
1901	...	...	...	...	1	—
1902	...	...	...	...	1	1
1903	...	...	...	...	—	1
1904	...	...	...	...	—	—
1905	...	...	...	...	*1	2
1906	...	...	...	...	—	1

* In this case the fatal malaria attack supervened on long serious non-climatic disease.

More influence can be brought to bear on officials than on other European residents as to prophylaxis and early treatment.

(2) Total deaths of Europeans from:—

—					Malarial Fever.	Blackwater Fever.
1897	...	...	...	...	11	2
1898	...	...	...	...	4	—
1899	...	...	...	...	12	3
1900	...	...	...	...	10	7

Anti-mosquito work started and quinine prophylaxis is more emphasized during latter part of 1900.

—					Malarial Fever.	Blackwater Fever.
1901	...	...	...	...	6	4
1902	...	...	...	...	4	5
1903	...	...	...	...	5	2
1904	...	...	...	...	6	2
1905	...	...	...	...	6	2
1906	...	...	...	...	5	4

Result of weekly quinine ration to men of West African Frontier Force in 1905. Cases of malarial fever from January to December, both inclusive, in 1904 numbered 165, and in 1905, 52, or a decrease of more than two-thirds.

8. *Conclusion.*

Although undoubtedly much remains that can, and should, be done, a great amount of useful work has been accomplished. The importance of fighting the mosquito plague has been brought home to the European population, both official and non-official. It is noticeable that the District Medical Officer at Degema reports that the agents of the trading firms frequently consult him as to precautionary measures against the breeding of mosquitoes, and this is merely one of the instances indicating the trend of the opinion of the mercantile element in this matter. Lectures and instruction among the natives have not been fruitless, and it is a hopeful sign that, especially in the Western and Central Provinces, the natives are beginning to take an interest in the question. The filling in of the large hole at Benin City, referred to above, has been largely assisted by voluntary native labour. A report from this station states that "due to excellent work in the past, Benin City is now nearly mosquito-free in the neighbourhood of the bungalows," and it is an undoubted fact that the number of mosquitoes found in European dwellings has already been very greatly decreased throughout the Colony and Protectorate.

In conclusion, the following remarks of the Principal Medical Officer may be quoted:—

"One must note with much satisfaction the very great change in the Colony in the matter of malaria among European officials that has taken place during the period of which I have personal knowledge—nine years. Attacks of fever at frequently recurring intervals were regarded as inevitable during the first few years of my residence here. That is not the case now. I can remember the time when at any little social gathering, say a dinner-party, there would be one or two vacant chairs, owing to the fact that some of the invited guests had suddenly 'gone down with a touch of fever,' as the phrase was. This I have not seen for many a long day. Such experience is of value when forming a general opinion as to the decrease of malaria. It is difficult to produce reliable statistics, but when the marked increase of the European population during the past few years, and especially during the last five years, is taken into account, and the malarial death-rate examined, it will be seen that the mortality has greatly diminished. The same is true of the number of recorded cases apart from the number of deaths resulting from the disease; and this affords good ground for hoping and believing that in the future malaria will not play the fatal part it did in former years."

EXPENDITURE on Anti-Malaria Work in Lagos from 1901 to 1906, by Medical Department, and exclusive of such work done by Public Works Department.

Particulars of Expenditure.	Detail of Service.	1901-1902.	1902-1903.	1903-1904.	1904-1905.	1905.	1906.	Total.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Medicine, &c., against Malaria.	Quinine ..	657 0 0	—	146 12 6	165 19 2	120 16 5	187 14 2	1,322 2 3
	Creosote ...	—	5 18 8	—	7 15 0	—	16 9 1	30 2 9
	Larvicide ...	—	6 2 0	—	—	—	—	6 2 0
	Crude Kerosine.	—	2 6 3	—	—	9 10 0	—	11 16 3
	Kerosine ...	—	7 8 3	5 10 0	7 10 0	—	8 1 0	28 9 3
Mosquito Catcher.	... ..	—	—	6 0 0	6 0 0	6 0 0	2 0 0	20 0 0
								1,418 12 6

1. In considering the question of expenditure for anti-malarial work, it is safe to say that as all the medical officers, sanitary inspectors, and scavengers aid in this work, a fraction of their salaries—impossible to estimate—may be considered as a contribution to that expenditure, but it can hardly be regarded as special expenditure on that work.

2. Expenditure on such important anti-malarial work as drainage, swamp reclamation, and bush cleaning, are not here dealt with. The Medical Department cannot give reliable information on this portion, but Public Works Department no doubt has done so.

H. STRACHAN,
Principal Medical Officer.

August 10, 1907.

SOMALILAND PROTECTORATE.

MEDICAL REPORT, 1906.

(Extract.)

Malarial Fever.—As reported at the end of last year, the sequence to the increase of malaria then drawn attention to, has marked the year 1906 by an outbreak of remittent fever among the European staff on the coast. The sources of origin were persons arriving from East Africa and Burma; both of these parties would seem to have caused an infection. This year there have been 539 cases as against 117 in 1905 and nine cases only in 1904. The matter is serious and is likely to be more so, unless the public works in connection with the removal of insanitary buildings and of old concealed cesspits and drains can be pushed forward. No natural breeding grounds exist for mosquitoes, and no malaria should occur if rudimentary precautions with regard to vegetation and drainage were adopted, as was pointed out in 1905.

BRITISH CENTRAL AFRICA PROTECTORATE.

THE DEPUTY COMMISSIONER to THE SECRETARY OF STATE.

Government Offices, Zomba, British Central Africa,

MY LORD,

August 10, 1906.

I HAVE the honour to acknowledge the receipt of Your Lordship's circular despatch of the 6th of June, 1906, and, in accordance with Your Lordship's instructions, beg to transmit a special report on the measures taken to eradicate malarial fever in this Protectorate, which has been prepared by Dr. Hearsey, the Principal Medical Officer.

2. This report is intended to be supplementary to the Principal Medical Officer's report, which formed Annex No. II,* of the annual report, which was transmitted home under cover of the Commissioner's despatch of the 30th of June, 1906.

3. In future a separate section will be included in the annual report dealing with this subject, in accordance with the instructions contained in the circular under acknowledgment.

I have, &c.,

F. B. PEARCE,

Deputy Commissioner.

* See page 49 of Colonial Reports—Annual, No. 499.

Enclosure.

LETTER from the PRINCIPAL MEDICAL OFFICER reporting on the Measures taken to eradicate Malaria, &c.

Supplementary to Annex II.* of the annual report of the British Central Africa Protectorate for 1905-6, transmitted in British Central Africa despatch of the 30th of June, 1906.

SIR,

Zomba, August 8, 1906.

IN reply to your letter with reference to His Majesty's Colonial Secretary's despatch on the subject of malaria, I have the honour to inform you that the measures which have been undertaken in this Protectorate during the past few years with the object of eradicating malaria may be summed up as follows:—

- (1.) Measures directed towards the extermination of mosquitoes;
 - (A) The clearing of grass and scrub in and around European settlements.
 - (B) The filling up of pools and puddles, and the drainage of larger collections of stagnant water (where possible), in order to destroy their breeding grounds.

NOTE.—In addition to the above measures, which may be said to be in general application, others, necessitated by reason of the special circumstances associated with the position of a township or settlement, have been called for.

Thus, at Fort Johnston, which is situated on the banks of the Upper Shiré, it has been found necessary to expend annually a certain sum of money for the purpose of gradually "building up" both banks of the river fronting the township, in such a manner as to prevent the collection of stagnant water along the sides of the banks. There are, however, extensive marshes in the immediate neighbourhood, with which it would be impossible to deal. Towards the termination of the rains the river rises, flooding the surrounding low-lying country. At this time of the year mosquitoes are numerous. With the approach of the dry season the river again falls and the marshes disappear, partly by draining into the river and later by evaporation. Mosquitoes at this season are distinctly on the decrease, and during the few following months are hardly noticeable.

The same remarks apply, with certain modifications, to another large settlement—Chiromo, situated on the banks of the Lower Shiré and Ruw Rivers, and having in its neighbourhood extensive marshes. Here, however, any attempt to build up the banks would be futile, as the rapidity of the rivers during the wet season would wash away any such artificially-constructed banks. The borrow pits made by the railway which runs through the settlement were last year suspected to afford breeding places for mosquitoes, but the subsequent observations of the Medical Officer during the wet season showed that rain water collecting in these pits percolated so rapidly as not to admit of the breeding of mosquitoes in them. Barges moored alongside the banks have on several occasions been found to contain larvæ in the water which had leaked into them, and these are now periodically inspected.

Chikwawa and Katungas, situated on the banks of the Lower Shiré, and having extensive marshes in their neighbourhood, have now been practically abandoned, for business reasons.

The above may be taken as examples of "river" stations.

To come to the "lake" stations, of which Kota Kota and Karonga may be cited as instances.

At Kota Kota there is a large native population settled on the lake shore, and engaged mainly in the cultivation of rice, which may be regarded as the staple industry. It is evident, therefore, that the surrounding country is sufficiently marshy to admit of the cultivation of this product; and mosquitoes are consequently very numerous. The Government station has been shifted further back from its original site, and to a comparatively higher elevation, where mosquitoes are not so numerous as at the old site.

At Karonga the conditions are somewhat different, but the same proximity of marshes prevails, and mosquitoes are abundant during the wet season.

The question of dealing with these extensive marshes presents difficulties which

* See p. 49 of Colonial Reports—Annual, No. 499.

are well nigh insuperable, except perhaps in isolated instances, and then only at a prohibitive cost.

The encouragement of cultivation (other than that of rice) in the immediate precincts of marsh-surrounded settlements, and the attendant drainage which would be necessitated, appears to offer the only solution to the difficulty.

European settlements in the highlands are by no means free of mosquitoes, and here collections of still water along the course of streams offer the requisite breeding grounds for mosquitoes, which, during the warmer months of the year, are sometimes distinctly numerous. This has been particularly noticeable in the case of Zomba during the past few years, and I think there can be little doubt but that the reason for this increase within the township must, in the main, be ascribed to the larger number of artificial water channels which now intersect it. Periodical flushing of those channels issuing from the main channel which supplies power to the electric light installation has been suggested to the Medical Officer as a means of dislodging larvæ which may have hatched along their course. But notwithstanding this noticeable increase of mosquitoes, it is undoubtedly the fact that there has been no proportionate increase of malaria; on the contrary, the number of cases now presenting themselves for treatment shows an appreciable decrease. This can only be accounted for by the following:—

(2.) Measures directed against the spread of malarial infection.

(A) Treatment of all cases under mosquito nets.

(B) The removal of natives, their wives, and children, from within European settlements, and their segregation in "native locations."

NOTE.—Seeing that a large proportion of native children are infected with malaria, and are consequently the principal foci of infection, much importance has been attached to this measure, and, as regards Zomba, where the segregation of natives is more or less rigidly carried out, the resultant effect has been a marked diminution in malaria, notwithstanding the increase of mosquitoes, as already pointed out.

(3.) Measures bearing on personal prophylaxis.

The public fully realizes the rôle played by mosquitoes in the dissemination of malarial fever, and advice regarding the use of mosquito nets and wire gauze netting, avoidance of camping near villages, and the necessity for taking occasional doses of quinine, &c., &c., has been freely given.

With regard to the question of statistics showing what measure of success has been attained by the application of the above principles, I am in a position to say, that with the exception of Chiromo, there has been a decided decrease of malaria among Europeans; that the "pernicious" forms of malarial infection are now rarely met with; and that as regards "blackwater" fever, although the number of cases during successive years vary somewhat, the mortality from this type of infection has fallen within the last seven years from 66 to about a minimum of 10 and a maximum of 15 per cent., due entirely, I believe, to the different method of treatment now adopted, and not to any change in its type or virulence—a statement not infrequently made by the public in consequence of the much diminished mortality.

With reference to Chiromo, it is necessary to add that the returns of malaria from this station have shown an increase only since the arrival of employees of the railway, the largest proportion of cases of malaria amongst whom, however, is contracted outside the township, and who, by reason of their employment, habits of life, &c., are especially liable to suffer.

I have, &c.,

H. HEARSEY,

Principal Medical Officer.

His Majesty's Commissioner.

West Indies.

JAMAICA.

THE GOVERNOR to THE SECRETARY OF STATE.

MY LORD,

King's House, Jamaica, September 22, 1906.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch, dated 6th June, 1906, in regard to the return, asked for by Major Seely in the House of Commons, of the measures taken in the Colonies to eradicate malarial fever.

2. I requested the Superintending Medical Officer to furnish a report on this matter, and I enclose, for your Lordship's information, a copy of a letter from which it will be seen that no measures have been adopted by any public authority in this Colony for the prevention of mosquito-borne disease in the past year.

3. I have directed the Superintending Medical Officer to furnish, for transmission to your Lordship's Department with his usual annual report, a special supplementary report, such as is indicated in the fourth paragraph of the circular under acknowledgment.

I have, &c.,

J. A. SWETTENHAM,

Governor.

Enclosure.

ACTING SUPERINTENDING MEDICAL OFFICER to COLONIAL SECRETARY.

SIR,

Island Medical Office, Kingston, September 14, 1906.

I HAVE the honour to acknowledge the receipt of a circular letter, dated the 6th of June, 1906, from the Right Honourable the Secretary of State for the Colonies, referred to me on the 2nd of July for my report.

I addressed a circular letter, asking for information in terms of the Secretary of State's despatch, to all the District Medical Officers, and to other officials in the island whose position or attainments might, I thought, afford them opportunity for the acquisition of knowledge on the points outlined in the despatch. A careful consideration of the replies received establishes the fact that although individual efforts, and measures remotely or indirectly affecting the question may have been put in practice to a variable extent throughout the island, no measures for the prevention of mosquito-borne disease have been adopted by any public authority in the Colony during the past financial year.

There are no reliable statistics available to supply the information asked for in the latter part of paragraph 4 of the Secretary of State's despatch.

I have, &c.,

The Honourable

The Colonial Secretary,

Kingston.

H. L. CLARE,

Acting Superintending Medical Officer.

BRITISH HONDURAS.

MEDICAL REPORT, 1906.

Belize District.—Dr. J. H. H. Harrison.

(Extract.)

33. *Screening Ordinance.*—In January the Screening Ordinance was passed, and by the end of the year every tank and cistern had been properly rendered mosquito proof. The Inspectors of Nuisances make a diligent survey of the town every day, and inspect the condition of the yards as well as such water receptacles the people may have in use. With regard to this, all varieties of receptacles are used, from old tins to barrels, the latter predominating, causing us much vexation, inasmuch as the people are slow to comply with the requirements of the law, and yet it is hard to deprive them of the only storage they possess, as they have to fetch the

water from some distance and store it in these receptacles. However, due warning is given the owners, and if they do not respond to the law and the inspectors are satisfied as to the presence of wrigglers, the barrels are upset.

BRITISH GUIANA.

MEDICAL REPORT, 1906.

C.—*Malarial and other Fevers.*

(Extract.)

The statistics show that malarial fever is generally prevalent. This is only to be expected when we know that the malarial-carrying mosquito is one of the commonest found in the Colony. On the sugar estates alone 23,332 cases of malarial fever were treated in the different Estates' Hospitals. But it is gratifying to learn from the report of the Medical Inspector that there has been a marked decrease in the number of cases during the past few years. This is no doubt due in a large measure to the steps taken to improve the drainage of the yards and surroundings of the labourers' cottages, the removal and burial of tins, &c., thus diminishing the number of mosquitoes by doing away with their favourite breeding places.

The Medical Inspector has started an active campaign against the use of barrels, &c., near to the labourers' cottages on the sugar estates, for storing water, unless they are properly screened with mosquito-proof gauze.

From personal observation I am glad to record that the inhabitants of the Colony generally take a much more lively interest in the extermination of mosquitoes than they did a couple of years ago. This is only what one would expect from the amount of literature that has been published of late with regard to the mosquitoes, their danger to the health of the community, and the means for their entire or partial extermination. But I should like to see a much more vigorous campaign against mosquitoes, and one of the first steps should be compulsory screening of all tanks, &c., used for storing water.

The recent outbreak of yellow fever in British Honduras was stopped by a vigorous campaign against mosquitoes. If, unfortunately, yellow fever was introduced into this Colony there would no doubt be great activity displayed in the above direction. We should have to act promptly, and the cost would be considerable. It is, therefore, surely better that we should be fore-armed and gradually adopt every measure known for the extermination of mosquitoes and not wait until we are compelled to take these measures. It is well that the people of this Colony should know that the yellow-fever-bearing mosquito is one of the commonest, especially in Georgetown.

It must also be borne in mind that mosquitoes carry other diseases besides malaria and yellow fever, namely, elephantiasis, "Rose," and other forms of filarial infection. I am afraid our long association with mosquitoes has made us rather under-rate the danger they are to the community. We have become accustomed to the diseases which are spread by their agency, and look upon these diseases as being part and parcel of the Colony. I trust that the inhabitants will wake up to the danger to which they are daily subjected and do everything in their power to diminish the number of these pests, thus reducing the diseases spread by them.

ANNUAL REPORT—ESTATES AND ESTATES HOSPITALS, 1906.

(Extract.)

With regard to the prevention of malarial fever I have already shown that a good deal of improvement has taken place in the condition of the yards, and I hope to see still greater improvements in the near future. But in a very flat country like this, with a very heavy rainfall, the task of removing all stagnant water is a most difficult one. However, a great deal more attention is now being paid to the removal of empty bottles and tins, to the keeping clear of small drains, and the filling up of small holes; and I have pointed out that good results have already followed. There is, however, one more point that needs careful attention and which, I must confess, I have only seriously attacked within the last few months; that is the water barrels and tins which the immigrants keep at their houses

for storing rain-water. I have lately ordered that these must be either removed or properly screened. I cannot recommend their wholesale removal because, as a rule, the water supply is defective; but if each estate had, as it should have, a proper water supply conducted by pipes to within easy reach of each range, then there would no longer be any excuse for the barrels which are most favourable breeding places for mosquitoes. In all these matters of sanitation I have, of course, received the greatest possible assistance from my colleagues in charge of the different districts, and I must thank them for their hearty support and co-operation.

BARBADOS.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

MY LORD,

Government House, July 18, 1906.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of the 6th ultimo, requesting that information may be furnished in the annual medical reports respecting the measures taken in this Colony to eradicate malarial fever, yellow fever, and other mosquito-borne diseases.

2. In reply I have to state that no annual medical report is compiled in this Colony, and that, although, as explained in the enclosed copy of a minute by the Poor Law Inspector, filariasis, which is generally believed to be a mosquito-borne disease, is extensively prevalent in the Island, the responsible authorities (the General Board of Health, and the Health Commissioners) have hitherto declined to take any measures to attempt to check the disease by preventing the increase of the mosquito.

3. I find that during the visit to the Colony in 1901 of Dr. G. C. Low, of the London School of Tropical Medicine, considerable attention was directed to this matter. Dr. Low delivered lectures on the subject to the Parochial Medical Officers and the Health Commissioners, which were subsequently printed and widely distributed, and endeavoured in every way to impress upon the community the importance of the matter, and the necessity for taking active measures to prevent the breeding of mosquitos in the water stored for domestic purposes; but although the Governor made strong efforts to induce the authorities to act upon his advice the Health Commissioners resolved that there was no necessity to do so, while the General Board of Health, which apparently held the same opinion, decided that the question was one to be dealt with by the Commissioners and not by the Board, a decision which was heartily approved by the local press.

4. I am confident that in the present state of public opinion here in such matters any attempt to again bring the question under consideration would lead to no better results.

I have, &c.,
S. W. KNAGGS,
Acting Governor.

Enclosure.

MINUTE by the POOR LAW INSPECTOR.

HONOURABLE COLONIAL SECRETARY,

MALARIA does not exist in Barbados, owing to the absence of the anopheles mosquito.

2. Of other mosquito-borne diseases, yellow fever occurs rarely on shore (last epidemic in 1881), and occasionally in the port in ships from infected places; filariasis, which is generally believed to be mosquito-borne, prevails extensively.

3. No mosquito measures have been directed against these two diseases, except that two wards of the infectious diseases hospital at the quarantine station were made mosquito-proof by brass wire gauze some years ago, and here cases of yellow fever from the shipping are treated.

4. Some years ago the Board of Health declined to take the steps recommended to control the prevalence of mosquitos.

5. There is no annual medical report from this Colony.

JOHN HUTSON.

July 9, 1906.

BAHAMAS.

ANNUAL MEDICAL REPORT, 1906.

(Extract.)

No measures have been taken by this Government for the prevention of malarial fevers, yellow fever, and other mosquito-borne diseases.

The Board of Health recommended a number of simple and practical rules for the suppression of mosquito-borne diseases, but was thought by the Administrator and Executive Council to be *ultra vires* and, therefore, not adopted; however, a number of brochures, entitled "The Prevention of Yellow Fever," have been obtained from the Colonial Office and freely distributed in this island and among the out-island Resident Justices.

ST. LUCIA.

MEDICAL REPORT, 1906.

(Extract.)

. . . We hope that during the present year the tanks will be screened and repairs executed to prevent the breeding of mosquitoes. I understand that steps will be taken to have the hospital boundaries defined and the grounds enclosed; with this, we hope to keep the place cleaner, and, with a little more gaol labour, free of heavy undergrowth. . . .

GRENADA.

MEDICAL REPORT, 1906.

(Extract.)

Richmond Hill.—Malarial fever has been much more prevalent and of a more serious type than usual. This I attribute to persons returning from Panama with the parasites in their blood. We have several species of anopheles in the island, and the disease is readily carried by them to persons in the immediate neighbourhood. I have good specimens of the crescent form of the malignant parasite which I have taken from the blood of persons who have returned ill with fever from Panama.

The drains along the main road between St. George's and St. David's are defective, and owing to the number of hydrants of the St. Paul's Waterworks along this road, these drains are constantly full of stagnant water. This district is thickly populated, the houses are close to the road and the drains. Owing to the careless habits of the people, this will not be an easy matter to deal with. Pails are put under tap, the water turned on and allowed to run along after the pail is full, thus creating a nuisance as well as wasting the water. Drains of this kind offer suitable breeding places for the anopheles mosquito. Concrete drains at every hydrant are necessary. Complaints are also made that fish is cleaned at some of these hydrants. A police patrol along this road would be of some use to prevent these and other breaches of the law.

St. Andrew's.—With reference to circular 1281/1906 stating medical officers should state what anti-malarial sanitation has been effected in the town of the district during the year, I much regret to state none. Want of means is urged.

St. Patrick's.—No measures directed to the eradication of malarial fevers or other mosquito-borne diseases were undertaken during the year in the district.

St. George's.—The only anti-malarial measure being carried out is that of filling in the swamp at Queen's Park with refuse from St. George's town. Apparently it will be some considerable time before this is completed.

Carriacou.—The measures taken to deal with this endemicity of malarial fever are little or none; quite recently an attempt was made to fill up a rainy-season swamp, but this proving unsuccessful, an attempt at drainage is being made.

The sandy nature of the soil in Carriacou does not admit of the formation of puddles or pools, and repeated examination has proved that mosquitoes do not breed in the ponds and wells.

ST. KITTS-NEVIS.

EXTRACTS FROM MEDICAL REPORT, 1906.

Mosquitoes.—These insects are carriers of malaria, yellow fever, filariasis, and leprosy. Here in St. Kitts filariasis is a curse. More than 50 per cent. of the adult population harbour this parasite. Leprosy is very prevalent here—eight new cases occurring in my practice during the year. Malaria is also becoming common.

Here we have four terrible diseases that are spread through the agencies of mosquitoes. One would think that any far-seeing community would try every means to get rid of these dangerous insects. What do we find in St. Kitts? Nothing whatever is done to destroy the breeding places of the mosquitoes; on the contrary, every facility is given to these insects to breed throughout the island.

Any stranger driving round the island, and seeing the holes half full of water at the sides of the roads, would think that the breeding of mosquitoes was one of the minor industries of the island.

We shall surely have an outbreak of yellow fever in this community unless a very energetic campaign is waged against all mosquitoes. This danger is greater now than it has ever been, on account of the number of labourers returning here from Panama. This danger is real and imminent.

Destruction of Mosquitoes.—The record of sanitary work is not great, and some effective measures ought to be taken in filling up pools, destruction of mosquito larvæ, &c.

The introduction of the fish “Millions” into our ponds and ornamental waters will be watched with interest.

Southern Pacific.

PAPUA.

THE GOVERNOR-GENERAL OF AUSTRALIA to THE SECRETARY OF STATE.

MY LORD, Governor-General's Office, Melbourne, November 13, 1906.

REFERRING to your Lordship's circular despatch of the 6th June last (British New Guinea), respecting the measures taken in British Colonies to eradicate malarial fever, I have the honour to enclose herewith, for your Lordship's information, a copy of a report on the subject received from the Administrator of Papua.

I have, &c.,
NORTHCOTE,
Governor-General.

Enclosure.

SIR, Government House, Papua, October 10, 1906.

ADVERTING to your despatch of the 18th of July last, enclosing three copies of a Colonial Office Circular despatch, dated 6th June, 1906, calling for returns of the measures taken in British Dependencies to eradicate malarial fever, I have the honour to inform you that the only systematic attempt to combat the disease has been made on the island of Samarai—the chief town and centre of European population in the territory. Being a small island, situated two miles from the mainland, the difficulty of exterminating anopheles mosquitos was not great. A swamp, which formerly existed on the island, has been filled in and drained. Periodical inspections are made of all the premises on the island, and careful search for receptacles which might serve as breeding places for mosquitos is made. The result is that anopheles, which were at one time prevalent there, are now believed to be wholly exterminated, and that malarial fever among those Europeans who permanently reside on the island has practically disappeared.

At Port Moresby, where the climate is dry, anopheles are rare. Such cases of malarial fever as occur there are probably almost invariably due to infection derived elsewhere.

During the last three years two Government stations have been removed from mosquito-infested sites to sites more remote from mosquito breeding places with good results to the health of the occupants of the stations. The advisability of using mosquito nets and taking prophylactic doses of quinine is clearly understood by all the officers of the service. Each station is provided with a copy of Dr. Simpson's "Maintenance of Health in the Tropics," and by this means they are instructed in the reasons for taking the usual precautionary measures against malarial infection.

At some of the mission stations simple steps have been taken to improve the health of the inmates with surprisingly beneficial results, especially by such means as, where practicable, the doing away with proximate breeding places of mosquitos.

It is satisfactory to be able to state that the health of Europeans in Papua has improved greatly during the past few years, and I attribute this improvement largely to many individuals acting in accordance with the knowledge that mosquitos are the disseminators of malarial fever.

I have, &c.,

F. R. BARTON,

Administrator.

The Honourable

The Minister for External Affairs,
Melbourne.

South Africa.

SOUTHERN RHODESIA.

THE ADMINISTRATOR to THE SECRETARY OF STATE.

MY LORD, Administrator's Office, Salisbury (Rhodesia), August 9, 1906.

I HAVE the honour to acknowledge the receipt of Your Lordship's Circular despatch of the 6th June last, enquiring what precautionary measures have been adopted in this territory for the eradication of malarial fever and other mosquito-borne diseases.

In reply, I have the honour to transmit herewith copy of a report upon the subject by the Medical Director, which gives the information asked for.

I have, &c.,

W. H. MILTON,

Administrator.

Enclosure.

SIR, Medical Director's Office, Salisbury, August 2, 1906.

WITH regard to the despatch from the Right Honourable the Secretary of State for the Colonies, enquiring what precautionary measures have been adopted in this Colony for the eradication of malarial fever and other mosquito-borne diseases, I would point out that in urban areas of Southern Rhodesia, malaria has practically ceased to exist, and is only now rife in rural districts and in low-lying parts of the Colony, the mere settlement of communities in towns in the higher portions of the countries having gradually been followed by the disappearance of the disease.

From the last returns available it was found that 572 cases of malaria and 37 cases of blackwater fever were treated in hospitals in Southern Rhodesia during the year 1st April, 1905, to 31st March, 1906, with a death-rate of 1.22 per 100 cases of malaria and 21.62 per 100 cases of blackwater fever, or a total death-rate of 2.46 per 100 cases.

These however, were only the serious cases removed to hospitals. A large number of persons, especially in outlying districts, suffer annually from periodical attacks of malaria for which they do not even call in a medical man, and it would

be impossible to arrive at any conclusion as to the amount of malarial fever annually existent in the country.

The total deaths from malarial and blackwater fever throughout the country amounted to 34, or 2.69 per mille of the population. The total death-rate was 14.4 per mille, therefore, malarial fever and its complications were responsible for .186 of the total deaths.

With regard to the precautions adopted for the eradication of the disease, in towns in Southern Rhodesia, systematic crusades are unnecessary as the disease is little known. In rural districts, any mosquito crusades except in the vicinity of mining and police camps are hardly within the sphere of practical politics.

The Government has within the last few years placed all police stationed in malaria-infested regions in mosquito-proof barracks; in addition, every member of the force is supplied with a mosquito net. The result of this has been that malarial fever amongst the British South Africa Police has been reduced by 50 per centum in the last two or three years, and that in spite of their having to patrol in all seasons and at all times of the day and night.

For the rest, every effort has been made, and is being made, by the Government to educate the settler as to the causes of malaria, and how best it may be prevented. Lectures have been given and pamphlets distributed with this intention, and certainly the farming and mining classes are coming, slowly I admit, but still surely, to recognise the advantages to be gained by the adoption of precautions against the bite and eradication of mosquitoes.

A. M. FLEMING,
Medical Director.

APPENDIX II.

THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received July 27, 1907.)

B 10, Exchange Buildings, Liverpool, July 25, 1907.

The Liverpool School of Tropical Medicine.

SIR,

As President of the Incorporated Liverpool School of Tropical Medicine, I respectfully beg to ask His Majesty's Principal Secretary of State for the Colonies that the grant made by the Colonial Office to the School may be increased from £500 to £1,000 per annum.

This application is based on the following grounds:—

- (1) The School is carrying on a work of vital importance to all British tropical colonies by assiduous research into tropical diseases, and, so far, its researches have met with conspicuous success.
- (2) The school is practically entirely dependent on voluntary contributions. As these contributions, in the seven years of the School's existence have reached—in round figures—£60,000 (see statement annexed), it is not unreasonable to ask that the Government should now assist in placing the institution on a sounder financial footing. The voluntary support hitherto given to the School by the general public is evidence of the value of its work.
- (3) The minimum annual amount required to carry on the work of the School on its present lines, and to extend the same, is at least £3,000, exclusive of expenditure on expeditions, erection of laboratories, and other special expenses.
Whilst hoping to continue to raise this sum, the Committee cannot guarantee to be able to do so.
- (4) Of the sum of £60,000, referred to in Section 2, His Majesty's Government have contributed £1,750 towards working expenses, and have, in addition, contributed £1,250 towards special expeditions.
- (5) In the autumn of the present year the School will have the following research expeditions at work in the tropics: (a) a yellow fever expedition in Brazil; (b) a sleeping sickness expedition in Rhodesia; and (c) a blackwater fever expedition in Central Africa. In addition the School has lent the services of the Professor of Tropical Medicine to the Colony of Mauritius for six months from October next.

Although, as far as possible, these expeditions are defrayed by special funds, they constitute indirectly a large drain on the general funds of the School.

I may point out that the Blackwater Fever Expedition is the nineteenth expedition sent to the tropics by the School.

In the light of the foregoing it is not necessary to add further arguments in favour of His Majesty's Government increasing the grant which at present it kindly makes to the School.

I trust, therefore, that this application may receive Lord Elgin's favourable consideration at an early date.

I am, &c..

ALFRED L. JONES,
President.

Enclosure in Appendix II.

THE INCORPORATED LIVERPOOL SCHOOL OF TROPICAL MEDICINE.

Honorary President: H.R.H. Princess Christian.

STATEMENT of Expenditure incurred by the School since its formation in 1899 to July 1, 1907.

A. Foundation of professorship and lectureship in tropical medicine and construction of the laboratories of the School	£21,000
B. Expenditure on 19 expeditions sent to the tropics for research purposes in the interests of British Colonies and British trade	16,200
C. Expenditure on research work at home in connection with the expeditions	3,500
D. Salaries of staff, and equipment for students, instruments, animals, &c.	14,500
E. Expenditure on printing the 21 memoirs of the School and the two volumes of the annals, and circulating the same	2,800
F. General expenses, office, &c.	2,000
Total	<u>£60,000</u>

APPENDIX III.

REPORT FROM THE ROYAL SOCIETY.

ABSTRACT OF WORK IN THE EXPERIMENTAL TREATMENT OF TRYPANOSOMIASIS CARRIED OUT DURING THE PAST YEAR UNDER THE SUPERVISION OF A SUB-COMMITTEE OF THE ROYAL SOCIETY.

These investigations were begun in December, 1906, and are still in progress.

The trypanosome diseases so far subjected to treatment have been nagana (tsetse fly cattle disease of Africa) and surra. Animals inoculated with these diseases die normally in 5·5 and 6·9 days, respectively.

The animals treated in these experiments have been principally rats.

A series of 15 chinolin compounds, cyanin, dichlorobenzidine + acid H, trypanroth, anhenal, sodium cacodylate, fluorescein, sodium cinnimate, tiodyne, six organic arsenic compounds, and sodium-arsenyl-tartrate have been carefully tested for their action upon animals inoculated with the diseases mentioned, but the results have been negative, or have at best only lengthened the life of the animals for a short period.

Arsenic has been used extensively, both alone and in combination with other drugs. Alone, either in the form of arsenious acid or of atoxyl, it has not effected a cure in any animal. Much better results have been obtained by its combination with other substances, especially mercury. Animals which have been treated with atoxyl and mercury are still living and well at 282, 275, 261, 231, and 217 days after inoculation, and many survived as long as from 170 to 206 days after inoculation, but ultimately died from other causes than the inoculated disease. This combination, however, has not so far realised our expectations, since, in small experimental animals there is great danger of damaging the kidneys with the mercury. This danger might be less in larger animals.

A phenomenon of importance has been observed in some of the rats used for experiment. Under certain conditions the trypanosomes appear to become proof against atoxyl, and to be no longer affected by its administration. In such cases the rat dies from the disease as if untreated.

These trypanosomes are far less susceptible to the action of other drugs (*e.g.*, antimony) than those which are not atoxyl-proof; and their virulence in animals appears to be increased; for in such cases there has invariably been recurrence and death after treatment with drugs other than atoxyl.

A large number of experiments have been carried out with various antimony compounds, the most successful being those made with sodium-antimonyl-tartrate. So far this drug has been found to have more effective action upon trypanosomes in the blood than anything which has yet been tried, not even excepting atoxyl. It is not irritating to animals; it acts with extraordinary rapidity (the trypanosomes, even when in large numbers, being driven out of the blood in an hour); and recurrences in cases treated with this substance alone are of far less frequent occurrence than in atoxyl cases. Rats which have been treated with this compound are now alive and well at 105, 102, 97, 96, and 84 days. From some which have died and from others which have been killed for the purpose, inoculations have been made into healthy animals, with invariably negative results. Experiments have now been begun on large animals with the object of further testing the powers of antimony; and experiments are also being carried out with various other antimony compounds, in order to find the form best suited for administration.

Some experiments have been made with the view of ascertaining whether any immunity is conferred upon an animal which was considered to be cured by treatment with drugs. A rat infected with the nagana disease was treated with atoxyl and mercury and showed no trypanosomes for 144 days. It was then re-inoculated on the 147th day after its first inoculation and it took the disease in the same way as a normal rat. It would thus seem that being cured of a trypanosome disease may confer no immunity against another attack.

Two papers with the details of the above work have been published in the Proceedings of the Royal Society.

December 16, 1907.

APPENDIX IV.

UNIVERSITY OF LONDON to COLONIAL OFFICE.

(Received December 7, 1907.)

SIR, University of London, South Kensington, S.W., December 6, 1907.
 I AM directed by the Principal to enclose two copies of the "London University Gazette" for December 4th, which contains a report from the Professor of Protozoology for the year ending June 30th, 1907.

I am, &c.,
 G. K. MENZIES,
 Secretary to the Academic Registrar.

Enclosure in Appendix IV.

REPORT FROM THE PROFESSOR OF PROTOZOOLOGY.

The following report from the Professor of Protozoology for the year ending June 30th, 1907, was received:—

I entered upon the tenure of my professorship in July, 1906, and began work at once in the laboratories at the Lister Institute of Preventive Medicine. I was then without assistants, except a laboratory attendant whom I had engaged, and my laboratory was without appliances for work. I was chiefly occupied, therefore, during the month of July in stocking the laboratory with necessary apparatus, reagents, &c., and in interviewing and appointing my two assistants, namely: Dr. J. D. Thomson, M.B., C.M., and Dr. H. M. Woodcock, D.Sc. I also finished off the preliminary report on my sleeping sickness work in Uganda in collaboration with Lieutenants Gray and Tulloch; our joint memoir was communicated to the Royal Society on July 10th and published in the Proceedings of the Royal Society, B, Vol. 78, pp. 242-258, pls. 12-14.

In the beginning of August I attended the meeting of the British Association at York and after that I took a holiday, returning to the Lister Institute about the middle of September.

During the winter and early spring I was occupied chiefly in working out my material of sleeping sickness brought back from Uganda. I discovered the encystation of *Trypanosoma grayi*, and communicated a preliminary report on it to the Royal Society on November 8th. My memoir appeared in the Proceedings of the Royal Society, B, Vol. 79, pp. 35-40. Encystation had not previously been observed in any trypanosome; the facts discovered have an important bearing on the problem of the dissemination of these disease-producing organisms. I was also occupied during this period in making a series of preparations of protozoa of all kinds, with the help of my assistant, Dr. Woodcock. These preparations are intended for teaching purposes, especially to illustrate my course of lectures.

On November 15th I gave an Inaugural Lecture at the University of London. In spite of the weather, which was of the worst possible description, I had an audience of about 300.

At Easter I visited the Marine Laboratory of Banyuls-sur-mer, Pyrénées Orientales, France, and spent some time making preparations of Marine Protozoa (Foraminifera) for my series.

During the months of May and June I gave a course of 23 lectures on Protozoa at the Lister Institute (Mondays, Wednesdays, and Fridays, 5 p.m.). Each lecture was followed by demonstration of illustrative preparations under the microscope. The average attendance at the lectures was 25, and did not fall below 20 on any occasion. The audience consisted of (1) University students preparing for degrees; (2) post-graduates; (3) medical men, amongst

whom I may mention especially Sir Havelock Charles, I.M.S.; Lieutenant-Colonel Alcock, LL.D., F.R.S., I.M.S.; Major Leonard Rogers, I.M.S.; Major Fowler, R.A.M.C.; Dr. Duncan J. Reid; Dr. H. S. Fremlin, of the Government Lymph Laboratories; and Drs. Dean, Marshall, and Ledingham of the Lister Institute; all of whom attended regularly.

During this time I finished the microscopic examination of my sleeping sickness material. A report has since been prepared for publication.

Amongst those who have worked in my laboratory I may mention Lieutenant-Colonel Alcock, I.M.S.; Captain James, I.M.S.; Major Leonard Rogers, I.M.S.; and Dr. Duncan J. Reid. My assistant, Dr. Thomson, has been working in collaboration with Dr. Plimmer on the curative treatment of animals infected with trypanosomes; a preliminary communication was made by them to the Royal Society on July 10th of this year. Dr. Thomson has also completed some work, not yet published but in the press, on the cultivation of fish-trypanosomes. Dr. Woodcock has been engaged upon various researches upon Protozoa; he has compiled the report upon Protozoa for the Zoological Record for 1906, and has completed an article, shortly to appear, on the Flagellata for Lankester's "Treatise on Zoology."

E. A. MINCHIN.

Lister Institute,
October 16, 1907.

APPENDIX V.

No. 1 in Appendix V.

LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received May 13, 1907.)

Seamen's Hospital Society, Dreadnought Hospital,

Greenwich, S.E., May 10, 1907.

SIR,

IN submitting to you the half-yearly reports from the helminthologist and protozoologist, I have been directed by the Committee of the London School of Tropical Medicine to give you a few particulars in regard to the general work of the School.

The study of helminthology and protozoology has been rendered possible by the generous assistance accorded by the Committee of the Tropical Diseases Research Fund, and a financial statement in regard to the expenditure of the grant made by the Fund was sent to you on the 29th ultimo.

The other work undertaken by the School has been paid for mainly by the fees from students, amounting to £2,312 5s. 2d., whilst the cost of the School for teaching, laboratory expenses, board of students, &c., amounted to £2,936 10s. 11d. The deficit of £624 5s. 9d. has been met by contributions from the general public.

This other work consists of clinics by the Honorary Medical Staff, Sir Patrick Manson, Dr. Andrew Duncan, Mr. Jas. Cantlie, Mr. Arthur Evans, Dr. F. M. Sandwith, and Dr. Daniels; of lectures on bacteriology, protozoology, hygiene, and helminthology by Professor Hewlett, Professor Simpson, and Dr. Sambon; and on special subjects, such as the diseases of the eye, skin, and mouth, by Mr. E. Treacher Collins, Dr. J. M. MacLeod, and Mr. K. W. Goadby.

Arrangements are made for abundant clinical work in the wards of the hospital, and the remainder of the time is occupied in laboratory work, consisting of the practical study of protozoology, helminthology, entomology, and bacteriology by the Medical Superintendent, Dr. Daniels.

The working hours are from 10 a.m. to 5 p.m., except on Saturday, when special classes are arranged at the London School of Clinical Medicine, Greenwich.

The details of the course are contained in the syllabus* which is sent herewith. There is a constant interchange of opinions, specimens, &c., between the various research laboratories abroad and the London School of Tropical Medicine, and the staff are constantly being appealed to for help and advice from various parts of the Tropics as to the prevention of disease.

The funds at the disposal of the School have not been sufficient to allow of any expeditions being sent in the past year.

The success of the School is shown by the number of students—now 705. During the year 1906 there were 95, as follows:—

Colonial Medical Service	...	...	...	...	25
Indian Medical Service	...	...	...	...	10
Royal Army Medical Corps	...	...	...	...	2
Royal Navy	...	...	...	...	1
Indian Civil Veterinary Department	...	...	...	...	1
Other Governments	...	...	...	...	2
Missionaries	...	...	...	...	14
Private students	...	...	...	...	40
					—
					95
					—

The majority of the students enter for the entire course of three months as will be seen from the following figures:—

3 months	...	...	...	...	65
2 months	...	...	...	...	18
1 month or less	...	...	...	...	12
					—
					95
					—

* Not reprinted.

Though the course is not specially arranged for the examination, out of the 45 men who have obtained the Diploma in Tropical Medicine and Hygiene at Cambridge, 38 were students of the London School of Tropical Medicine. Of the three successful students for the M.D. in Tropical Medicine, University of London, two had taken out the course at the London School of Tropical Medicine.

The past work of the helminthologist and protozoologist has consisted in the main during the last year of research work carried on under the superintendence of continental and Egyptian authorities.

The helminthologist has studied under Professor Looss in Cairo, and is now taking part in an expedition under the Egyptian Government to survey the region between Lake Victoria Nyanza and Lake Albert.

The protozoologist has been working under Professor Hertwig in Munich, and is now acting as Travelling Pathologist to the Wellcome Laboratory, Gordon College, Khartoum.

It was considered advisable that these officers should have opportunities—by study in the leading continental and other laboratories, and by actual field work in tropical countries—of making themselves masters of their subjects before they undertook more direct duties in connection with the London School of Tropical Medicine.

The actual original work already done by them is of importance, and an account of some of this is contained in the enclosed reports.

On their return they will take an active part in the teaching in the ordinary classes, and also conduct advanced courses in their respective subjects. In addition to this they will carry on original investigation.

Together with the reports of these officers are enclosed two publications by Dr. Leiper.

I am, &c.,
P. MICHELLI,
Secretary.

Enclosure 1 in No. 1 in Appendix V.

HALF-YEARLY REPORT OF THE HELMINTHOLOGIST OF THE LONDON SCHOOL OF TROPICAL MEDICINE.

London School of Tropical Medicine, Royal Albert Dock,

SIR,

London, E.

I HAVE the honour to submit my progress report for the half-year ending 1st May, 1907, as helminthologist to the London School of Tropical Medicine, and to forward herewith copies of papers published by me during the same period, viz.:—

- (1) The Etiology and Prophylaxis of Dracontiasis.* "British Medical Journal," January, 1907.
- (2) The Distribution of the "American" Hook Worm. "British Medical Journal," March, 1907.

The following papers have been completed and sent to the press, but are not yet published:—

- (1) Two new Genera of Nematodes occasionally parasitic in man.
- (2) The Turbellaria of the Scottish National Antarctic Expedition.

The first of the published papers deals with dracontiasis or guinea worm disease from the standpoint of prophylaxis, and has already been submitted to the Committee in manuscript; the second brings together, with new material, various points in the distribution of the American anchylostome that have come under my notice during the past two years.

It was generally thought that the *Necator americanus* was peculiarly associated with the New World, but this has been shown to be entirely fallacious. It is almost as world-wide in its distribution as its near relative, *Anchylostomum duodenale*, being found by me in West Africa, North-West Rhodesia, Uganda, Ceylon, Burmah, and Siam.

* Printed at page 45 *et seq.* of [Cd. 3306] January, 1907.

The paper in which "Two new Genera of Nematodes occasionally parasitic in man" are described deals with the results of one of the investigations followed out at the School of Medicine, Cairo, under Professor Looss, but only in so far as they relate to human infection. While engaged in Cairo upon helminthological studies along the lines detailed in my previous report, I had occasion to examine a supply of *Ascaris lumbricoides* received at the laboratory from the post-mortem room of the Kasr-Arny Hospital. Among them were several smaller, and at first sight apparently young forms. They differed, however, from the young of *Ascaris lumbricoides* in their peculiar resilience, and in the spatulate appearance of the anterior extremity. Microscopical examination revealed the presence of two membranous expansions at either side of the head, and thus at once distinguished the parasites as belonging to a different species from the common round worm. The "winged" ascaris, *Ascaris mystax* has been found several times by various observers as an occasional parasite of man, and it seemed likely that this formed a further case of such infection. The outline of the alæ convinced me, however, that the specimens from this case were not identical with those of *Ascaris mystax* found in the cat. A comparison of them with *Ascaris mystax* from a dog showed them to be identical. This was a surprising result, for it is held at the present day that the *Ascaris mystax* of the cat and of the dog belong to the same species. Continuing my investigations into the differences between the two forms, I found that they were divided from one another by such important anatomical characters as to leave no doubt of the distinctness of the species, and to raise the question as to their belonging to the same genus. Through the kindness of Professor Looss I was able to compare the internal structure of a large number of winged ascarides from various carnivora, and found that in each case the internal structure corresponded with that of either *Ascaris mystax* of the cat or *Ascaris marginata* of the dog. The distinctness of the two groups could no longer remain in question, and I have consequently created two new genera—toxascaris and belascaris, in which to place the various species of "winged" ascarides.

We have then in man a representative of each genus, viz., *Belascaris mystax*, which has been recorded as a human parasite nine times, and *Toxascaris marginata* of which this is the first record.

In addition to the above work bearing upon human medicine a considerable amount of work was done upon the parasites that produce pathological lesions in the lower domesticated animals, and several new types were found. These have not yet been fully described, and are being at present held over until by the accumulation of further material various gaps in their relationships to other forms may be more satisfactorily explained.

Since my return to London in February, I have been mainly occupied in sorting and classifying the collections made during the previous year and a half abroad. Type specimens of many of the species were mounted and placed in the Museum of the London School of Tropical Medicine. The method of preservation and mounting adopted was one calculated to make the specimens equally available for teaching, and for reference and future research.

A considerable quantity of material has been sent to me during the past three months for diagnosis and report, mostly consisting of parasites of the lower animals. One of the more interesting items deserves mention, viz., I was able to confirm the occurrence in pork imported into Britain from the United States, of *Trichinilla spiralis*. This is a parasite whose presence in pork can only be detected by microscopical examination, and that produces in man severe and occasionally fatal symptoms.

Some years ago the United States instituted a microscopic examination of all carcasses exported to Europe, and France and Germany insisted upon a high standard of inspection. It appears that of recent years, owing to the laxity of our own regulations upon the matter, the States Departments have ceased to exercise the same vigilance in respect to meat sent to England as that still required of them by Continental Powers.

I have, &c.,

ROBERT THOMSON LEIPER.

April 30, 1907.

THE DISTRIBUTION OF THE "AMERICAN" HOOK WORM.

Until quite recently it was universally supposed that the *Necator americanus*, the casual agent in the production of an anæmia clinically indistinguishable from that due in Europe to the *Anchylostomum duodenale*, was a parasite peculiar to the New World, and on this account it became designated the "American" or "New World" hook worm.

In the summer of 1905, however, Looss was enabled, from a study of the parasites of pigmies from the Ituri Forest, to record the occurrence of this form in Central Africa, and he offered the interesting explanation that the *Necator Americanus* was originally African, and had been transported thence to America at the time of the slave trade. As most of the slaves imported into the United States were procured from the Guinea Coast, it was to be anticipated that, if the theory were correct, this species would probably be still obtainable in West Africa, and this I found to be the case while on the Gold Coast in the latter part of 1905.

On my return I continued my inquiries with a view to ascertaining the extent of the distribution of the *N. americanus* throughout the old world, and found that the specimens brought from Entebbe, Uganda, by the Sleeping Sickness Commission, and deposited in the Museum of the London School of Tropical Medicine, and those forwarded to me from North-West Rhodesia by Dr. Yule Massey, were wholly of this species. It is evident, then, that the *N. americanus* is widely spread over the African Continent, though it is, curiously, absent from Egypt.

Farther inquiry has shown it to be still more cosmopolitan in its distribution. Dr. Chalmers has kindly furnished me with a large number of "ankylostomes" from natives of Ceylon, and they likewise show no admixture with *Anchylostomum duodenale*. I have also been able, from an examination of material obtained from a patient who had returned to England after working for some years in the gold-fields of Mysore, to verify its incidence in India. In a case from Burmah the infection was a mixed one. Stephens has already recorded necator forms from Assam and Burmah, but adds with reference to his material that "whether these species of necator include *N. americanus* remains to be seen."

In Chinamen I have so far only found examples of *Anchylostomum duodenale*. The absence, too, of any record from the active helminthological workers in Japan of its presence there is suggestive of a limitation in the range of *N. americanus* eastwards.

The local incidence of the two closely allied forms in various parts of the world remains still to be worked out, but it is at least obvious that the terms "american" and "new world" are in a sense misnomers as applied at the present day to the parasite under discussion, and that *N. americanus* is little, if any, less restricted than *Anchylostomum duodenale* in its distribution.

R. T. LEIPER, M.B.,
Helminthological Department,
London School of Tropical Medicine.

Enclosure 2 in No. 1 in Appendix V.

HALF-YEARLY REPORT OF THE PROTOZOOLOGIST OF THE LONDON SCHOOL OF TROPICAL MEDICINE.

During the past six months I have continued my investigations on the protozoa which inhabit the intestine of mice. This work I began in September, 1906, when I commenced my studies under Professor Richard Hertwig, in the Zoological Institute of Munich University.

Object of these Investigations.

It has been known for a considerable time that various forms of protozoa inhabit the alimentary canal of man and animals. It has very frequently been supposed that the parasites of each animal represent distinct species. This is far from being likely, and, indeed, it is much more probable that one and the same species of protozoa may live in the intestine and other organs of various animals, including man, provided the conditions are favourable to its existence. Various disorders,

especially of the alimentary tract have been attributed to these protozoa. The only reason for these conclusions is in most cases the presence of the parasite in the intestinal contents. Very little is known of these parasites apart from their adult structure, and even this is incomplete and inaccurate with the exception of the amœbæ of the human intestine, upon which numerous investigators have worked, including Schaudinn, who has given a life cycle for these protozoa.

In order to obtain a clearer idea of the nature and effect of these protozoa, and to confirm, if possible, Schaudinn's work on the amœbæ, my investigations on the protozoa of the intestine of mice were undertaken.

Types of Protozoa found in Intestine.

The protozoa living in the intestine may be divided into two classes. In one class would be included the coccidia, which are true parasites living in the cells of the epithelium, and destroying these to such an extent as frequently to bring about the death of the host. According to the researches of Schaudinn the *Entamoeba histolytica*, the cause of dysentery, is a true tissue parasite, and would be classed along with the coccidia. This parasite, however, is not found in the intestine of the mouse. In the second class of intestinal protozoa would be included certain amœbæ and flagellates, which might be considered more as commensals than true parasites. They live in various parts of the alimentary canal, and their presence and numbers have no relation to the health of the host. In some cases in a perfectly healthy animal, with no sign of diarrhoea they escape in large numbers from the intestine, and for anyone who simply examines the diarrhoeic stool it is an easy matter to conclude that the numerous protozoa are the cause of the trouble. It has been shown by Schaudinn and other workers that a large proportion of healthy individuals are infected with *Entamoeba coli* (*Amœba coli*), and this is doubtless true of other protozoa.

The protozoa found in the intestine of mice, and which are apparently harmless, are two forms of amœbæ and three flagellates, viz., *Trichomonas intestinalis*, *Lambliia intestinalis*, and *Hexamitus muris*. These will now be considered under their respective heads.

Amœbæ.

These will be considered first as they are of special interest in connection with dysentery, one type of which is supposed to be caused by these parasites. The frequent occurrence of amœbæ in dysenteric stools, the presence of amœbæ in the tissues round the dysenteric ulcers of the colon, and in the pus and walls of liver abscesses so frequently preceded by dysentery has given rise to this view. It was discovered that amœbæ occurred also in the normal intestine, and this has given rise to some confusion.

Schaudinn's Work on Intestinal Amœbæ.

As a result of his investigations Schaudinn said there were two distinct amœbæ which had been grouped together under the name *amœba coli*. The adult forms of these two amœba were very similar to one another, there being only slight differences, such as a variation in colour and distinctness of nucleus in the living amœba. There were, however, great differences in the mode of reproduction. One of these amœbæ, *Entamœba coli*, was a harmless parasite, which lived in the normal as well as in the abnormal intestine. It might also be found in the stools of dysenteric patients, but it had no connection with dysentery. This amœba formed cysts, which eventually through a somewhat complicated process of development, contained a mass of protoplasm with eight nuclei. These cysts measured 12u. and after escaping from the body of the host, were taken in by another animal which they infected. The second amœba, named by Schaudinn *Entamœba histolytica*, resembles *Entamœba coli*, and is easily confused with it. It forms cysts by budding off small masses of chromatin, containing protoplasm having a diameter of about 4u. These small masses of protoplasm become encysted, and are the means of transmitting the infection from host to host. *Entamœba histolytica* is a true tissue parasite, and is, according to Schaudinn, the cause of one form of dysentery.

Unfortunately, Schaudinn gave no illustrations to his paper, but I was able to confirm my observations on the amœbæ of the intestine of the mouse, the part of Schaudinn's work having reference to *Entamœba coli*.

Intestinal Amœbæ of Mice.

The advantage of studying the amœbæ in mice is that one can kill the mice and examine the intestine immediately after death. In this way all stages in the development of the amœbæ can be found. The amœbæ live in the cæcum in healthy mice, while below this level only encysted forms occur. In cases of diarrhœa free amœbæ may escape from the body. This amœba is indistinguishable from the *Entamœba coli*, the harmless amœba of the human intestine. In the cæcum it lives amongst the cæcal contents in company with *Trichomonas* and *Hexamitus*, and also upon the epithelial surface. It may wander into the glands, and make its way to the remotest extensions of these, but there is never any indication of its being able to penetrate the epithelial surface.

Mode of Reproduction.

Multiplication in the cæcum is by simple division of the body of the amœba after a mitotic division of its nucleus. The size of the amœba is anywhere between 10 and 40 μ .

The commencement of encystment takes place in the cæcum. The development of the cysts takes place as the cysts pass down the large intestine to escape from the body. The amœba rounds itself, and after casting out all foreign bodies, forms for itself a gelatinous cyst. The single nucleus of the amœba quickly divides into two, each of which gives off chromatin in the shape of two polar bodies. The two nuclei now reduced in size by the loss of chromatin divide mitotically by two spindles which lie parallel to one another in the cyst. This division gives rise to two pairs of nuclei which lie at opposite poles of the cyst.

The two nuclei of each pair now conjugate thus giving rise to a second binuclear stage. In this conjugation there has been an exchange of nuclear material between the original two nuclei. The two nuclei now divide once to form four nuclei, and these four to form eight. The cyst now contains a single mass of protoplasm with eight nuclei. During the course of this development a second membrane has been formed beneath the gelatinous sheath which itself has contracted to tough resistant cyst wall. In this condition the cysts escape from the body of the mouse. Outside the body they can resist a complete drying of the fæces, they give rise to infection in the new host. In the new host the cyst presumably ruptures and liberates eight small amœbæ, which commence to grow and multiply in the cæcum.

The course of this development corresponds with the description given by Schaudinn of the development of *Entamœba coli*, and as the adult forms of the two amœbæ are indistinguishable, one is driven to the conclusion that these two amœbæ are identical.

It is probable, as a consequence of these observations, that the *Entamœba coli* found frequently in the human intestine is not peculiar to man, but can also live in the intestine of various animals. Thus far Schaudinn's work has been confirmed.

It still remains to be seen whether there is an amœba distinct from this one which has the power of penetrating healthy epithelial surfaces, and of giving rise to dysenteric ulceration, an amœba, in fact, which is a true parasite comparable with the *Coccidia* and *Mynosporidia*.

Second Amœba from Intestine of Mice.

On two occasions when working with mice suffering from diarrhœa I have found in the lower parts of the large intestine an amœba, which is smaller than *Entamœba coli*. I have never found this amœba in the healthy intestine, but I have frequently found it multiplying rapidly in fæces which have been kept moist outside the body. It also grows very readily on the surface of the agar recommended by Musgrave and Clegg from the cultivation of amœbæ. The nucleus of this amœba is characteristic. It is spherical, and has all the chromatin massed to a granule at the centre of the sphere. In the moist fæces outside the body, and on the surface of agar cultures, large numbers of cysts are formed, and these cysts can often be found in the intestine of mice. It seems that these cysts pass through the intestine of the mice where they may undergo some change, and that the amœbæ leave the cyst if the fæces are kept moist. In some cases where the mice suffer from diarrhœa, the amœbæ may leave their cysts and multiply in the lower part of the large intestine.

This amœba is very similar to one I have cultivated from the stool of a dysenteric in which active *Entamœba coli* were present.

Cultivation of Amœbæ.

It has been claimed by many workers, and more recently by Musgrave and Clegg, that it is possible to cultivate the amœba of dysentery. After experimenting with numerous media they found one upon which amœbæ from the intestine would grow and multiply. In a certain number of cases in which amœba containing fæces of dysenteric patients were smeared on the surface of this agar, cultures of amœbæ were obtained. The amœbæ in the stool were apparently *Entamœba coli*, or one very much like it, while the amœbæ of the cultures differed in various ways from these. These differences were attributed to the change of medium in which the amœbæ were living. This assumption, of course, presupposes that only one form of amœba occurs in the intestine, a supposition which is found to be contrary to fact. In attempting to cultivate the amœba of the mouse, the one which is probably *Entamœba coli*, I have always failed, though following out very strictly the directions of Musgrave and Clegg. However, in a certain number of cases, the second amœba described above grew readily. These cultures correspond in every way with those obtained by Musgrave and Clegg, and described by them as cultures of *Entamœba coli*. So what has happened is that stools of dysenteric patients in which active *Entamœba coli* were found were used to inoculate the surface of agar plates. These fæces contained also the unrecognised cysts of another and distinct amœba which lives normally in decomposing matter outside the body, but the cyst of which frequently pass through the intestine. Amœbæ grew, and were thought to be *Entamœba coli*, though in reality they had escaped from the unrecognised cysts of a second form of amœba.

Trichomonas Intestinalis.

This is a flagellate, which lives in large numbers in the cæcum of mice in company with *Entamœba coli*. It is rarely, if ever, found above this level of the intestine. Various species of *Trichomonas* have been described, the differences between which are chiefly size and habitat. In studying the *Trichomonas* of the mouse one is struck by its great variation in size. Forms 20 u. in longest diameter are found, and all intermediate sizes down to 3 or 4 u. Another feature of *Trichomonas* is the ease with which it becomes deformed when removed from its natural medium. This applies especially to the larger forms which have a tendency to become amœboid. Escaping from the intestine in the fæces *Trichomonas* assumes a spherical form, and in this condition is very resistant, and may live from one to two weeks provided the fæces are not completely dried. These spherical forms are not encysted, for if the fæces after several days be mixed with a little normal saline solution, and the preparation examined on the warm stage, the at first motionless *Trichomonas* will, in the course of half an hour, gradually take on the movements and form characteristic of the active *Trichomonas*. The same result was obtained by mixing the fæces with the stomach juice of a freshly-killed mouse. In this latter case at the body temperature the *Trichomonas* remained active for five or six hours. These spherically contracted forms of *Trichomonas* could in this way pass through the stomach, and give rise to a fresh infection of the cæcum.

The peculiar resistance of *Trichomonas* renders it probable that the various species of *Trichomonas* described from the vagina, lung, mouth, and other parts of the human body are simply forms which have escaped from the intestine and found a suitable medium elsewhere, they are all of them probably *Trichomonas Intestinalis*.

I have worked out the complicated structure of *Trichomonas* and its mode of multiplication in the intestine.

Lamblia Intestinalis.

This flagellate inhabits the upper parts of the small intestine where it is frequently found with another flagellate, *Hexamitus muris*. *Lamblia* has a still more complicated structure than *Trichomonas*. Simple division in the free state as is so common amongst the flagellates does not appear to occur here, this may be due to its peculiar form. Before division each animal becomes encysted in an oval cyst within which the two nuclei, characteristic of *Lamblia* undergo certain changes, the end of which is the production of two smaller forms of *Lamblia* each with two nuclei.

Hexamitus Muris.

This flagellate lives in the small intestine, and occasionally lower down. One end is round and blunt, the other drawn out and tapering. From the blunt end there arise six flagellæ, while from the tapering end there arise two. These flagellæ are connected with an elaborate nuclear and blepharoplast apparatus.

Within the intestine multiplication is by division. Cysts are also formed which are responsible for the transmission of the infection.

A larger and somewhat different form of *Hexamitus* is sometimes found in the cæcum. This is probably a distinct species.

Hexamitus is capable of living and multiplying outside the body provided it comes into a fairly liquid medium. Several species of *Hexamitus* have been described as living in dirty water containing decomposing vegetable material. Some of these may be identical with forms living in the intestine of various animals.

The above-considered protozoa, *Amœbæ*, *Trichomonas*, and *Hexamitus* comprise what I have called the harmless protozoa of the intestine of the mouse. All of these have been found at one time or another in the human intestine, and all have been accused of causing diarrhœa or other intestinal troubles. This is due to the fact that normally these protozoa leave the intestine only in the encysted condition, and these encysted forms not being known, it has not been recognised that the normal as well as the abnormal intestine harbour these parasites.

The results of these investigations are appearing in the "Archives für Protistenkunde," in a supplementary number to be entitled "Festschrift für Richard Hertwig."

C. M. WENYON.

April 30, 1907.

No. 2 in Appendix V.

THE LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received November 13, 1907.)

Dreadnought Hospital, Greenwich, S.E.,

SIR,

November 12, 1907.

IN accordance with the arrangement entered into between the Colonial Office and the London School of Tropical Medicine in regard to the teaching of helminthology and protozoology, I have the honour to enclose herewith reports of the work done in these departments during the last six months, including a paper* by Dr. R. T. Leiper on the "Two new Genera of Nematodes occasionally parasitic in Man."

Since the last report was sent in a grant has been made by the Tropical Diseases Research Fund Committee for the teaching of medical entomology, and in accordance therewith the Board of Management of the Seamen's Hospital Society, acting on the recommendation of the School Committee, have appointed Colonel A. Alcock, I.M.S., C.I.E., F.R.S., to conduct this department. Colonel Alcock's title at the School will be that of "Arthropodologist," and I shall have pleasure in future in submitting to you his six-monthly reports. Colonel Alcock entered upon his duties at the School on the 1st of October, but up to the present he has been fully occupied in arranging his department, and he is not yet in a position to make any statement of value for your consideration.

In regard to the general work of the London School of Tropical Medicine, it is believed by the Committee of the School that it will be of interest to you to be informed that during the present year the following graduates have entered as students:—

Session commencing 15th January	...	...	...	...	24
Session commencing 1st May	...	...	...	...	37
Session commencing 1st October	...	...	...	...	29
					—
Total	...	...	...	...	90
					—

* Not reprinted.

Of these students 29 were from the Colonial Service.

„	„	14	„	Indian Medical Service.
„	„	1	„	Queensland Government Service.
„	„	2	„	United States Government Service.
„	„	1	„	Royal Army Medical Corps.
„	„	19	„	Missionary Societies.
„	„	24		Private students.
		—		
		90		
		—		

The students have entered for the following periods:—

For the full course of three months	...	...	...	...	55
For two months and over	...	...	...	...	24
For one month and over	...	...	...	...	9
For less than one month	...	...	...	...	2
					—
					90
					—

During the year 15 students entered for the Cambridge Diploma in Tropical Medicine and Hygiene, and 13 passed.

Two students have obtained the M.D. London in Tropical Medicine.

The Museum has been considerably added to during the year. The additions include valuable pathological specimens from former students from Tropical Asia, Africa, and America, parasitic entozoa in man and animals and photographs of various tropical diseases and sanitary or unsanitary conditions. Amongst noteworthy additions from others are a collection of native surgical instruments from Dr. Bolton Corney, Civil Medical Officer, Fiji, and a model of the cutaneous eruption in trypanosomiasis from Dr. Nattan Larrier, of Paris.

The Craggs's research prize of fifty pounds, awarded annually by Sir John Craggs, M.V.O., to a past or present student who has made the most valuable contribution to tropical medicine during the year, has been awarded to Fleet-Surgeon P. W. Bassett Smith, of the Royal Hospital, Haslar, for a paper on "The Therapeutical Treatment of Mediterranean Fever by Vaccines, &c."

I am, &c.,

P. MICHELLI,

Secretary.

Enclosure 1 in No. 2 in Appendix V.

HALF-YEARLY REPORT OF HELMINTHOLOGIST.

Helminthological Department, London School of Tropical

SIR, Medicine, Royal Albert Dock, E., November 1, 1907.

IN May last the Survey Department of the Egyptian Government Service organised an expedition to proceed to Uganda for the purpose of ascertaining the difference in level between Lake Victoria Nyanza and Lake Albert Nyanza, and to investigate other hydrographical questions bearing on the amount and periodicity of the water supply of the River Nile—matters of great utilitarian importance to Egypt and the Sudan.

It was felt that full advantage would not be taken of the great expense necessarily incurred if no biological inquiries were made at the same time, and it was accordingly arranged, with the sanction of the Committee of the London School of Tropical Medicine, that I should accompany the expedition and, while acting as medical officer, pursue helminthological studies in the countries traversed; it being, of course, understood that owing to the time limit imposed by the rainy season, and its attendant difficulties, the work should be of such a nature as not to interfere unduly with the primary programme.

The party left Egypt on the 5th May and returned on the 20th October, thus occupying the entire half year for which my report now falls due as Helminthologist to the London School of Tropical Medicine.

I am, therefore, able to give at present only a general account of the route

followed and of the nature of the investigations pursued, and am compelled to reserve for the next report any detailed descriptions of the material collected.

The party proceeded to Uganda viâ British East Africa, and thus had a short time to spend at Mombasa, where I observed from material kindly lent by Dr. Leys that the anchylostomiasis not uncommonly seen there as a severe and even fatal infection is due both to *Necator americana* and *Anchylostomum duodenale*.

A few days' stay was made at Nairobi, and was devoted to examining material connected mainly with diseases of the domesticated animals of the Colony, which closely concern the white settler, and in endeavouring to ascertain the specific nature of the parasite that had caused so much mortality amongst the experimental animals at the Government zebra farms. Through the kindness of Mr. Stordy, Chief of the Veterinary Department, who allowed me access to the entire collections of his laboratory, I was able to bring away specimens for the further study of the subject.

On my arrival at Entebbe I had the privilege of explaining to His Excellency the Acting Commissioner the nature of the investigations I hoped to make in the Protectorate, and he very generously granted me facilities at the hospital and laboratory at Entebbe, and relaxed the restrictions that might limit my examinations of the rarer animals of the Protectorate.

My stay enabled me to ascertain two facts of considerable interest, viz., the occurrence of the "American" form of the anchylostome only, as contrasted with the mixed infections seen at the coast, in material derived from native cases; and the presence in a native of Uganda of an apparently new nematode parasite.

This curious parasite belongs to the genus *Physaloptera* which has, up to the present time, been found but once in man. The Entebbe specimens differ not only markedly in size but also in the characters of the caudal extremity of the male from those recorded *Physaloptera caucasica*, so there seems every probability that the detailed examination later of the minute structure of this African form will result in the establishment of another new human parasite. For the material on which my observations in Entebbe were based I am indebted to Dr. Gray, of the Royal Society Sleeping Sickness Commission.

On leaving the capital we made our way to Lake Chioga, and thereafter to the Murchison Falls, where I spent some time unsuccessfully trying to implicate *Simulium damnosum* and a variety of mosquitoes as the intermediate host of *Filaria perstans*. From Fajao we marched to Butiabe on Lake Albert Nyanza, and thence proceeded homewards by the Nile to Egypt. During this part of the trip a very considerable collection of parasites both of the domesticated animals and of the wild birds and game of Uganda was made, but as stated previously, a considerable amount of time is required still to complete its investigation.

I have, &c.,
ROBERT THOMSON LEIPER.

Enclosure 2 in No. 2 in Appendix V.

HALF-YEARLY REPORT OF PROTOZOOLOGIST.

REPORT of Protozoologist for six months ending October 31st, 1907.

The past six months have been spent on the Nile and its tributaries in the Anglo-Egyptian Sudan, where I have been working in connection with the Wellcome Research Laboratories of the Gordon College, Khartoum. During one month of this time I remained in Khartoum where, at the Gordon College Laboratories and Military Hospital, I continued my investigations on intestinal amœbæ. For the remaining five months I have been travelling on the Nile in the recently constructed floating laboratory of the Gordon College. On the Nile my work has been chiefly in the three quarters, on the White Nile, near the junction of this river with the Sobat, at Nassei, on the Sobat, and at Wau, in the Bahr el Ghazal Province.

In addition to work which is purely protozoological, I have been occupied in collecting and making observations on biting flies (mosquitoes, *Tobanidæ*, *Glossinæ*, &c.), and parasitic worms.

Under work which is strictly protozoological I have studied intestinal amœbæ in Khartoum, trypanosomiasis as it occurs in various animals, flagellates in biting flies, and numerous blood parasites of mammals, birds, reptiles, and fish.

Below I will indicate as far as my present incomplete observations will admit the chief points in this connection.

Intestinal Amœbæ of Man.

These observations were made chiefly in the Military Hospital in Khartoum. The object was, first, to determine if any relation existed between the intestinal amœbæ of man and those of other animals. I have studied elsewhere the intestinal amœbæ of mice, and I have pointed out the close similarity of the developmental forms of this amœbæ with the simply verbal description given by Schaudinn of *Entamœba coli* of man. Schaudinn's description was accompanied by no illustrations, and I wished to determine by direct observation of both forms of amœbæ if any such relation existed.

Secondly, I desired to find out to what extent *entamœba coli* lived in the healthy human intestine.

In the first place I found nearly all stages of development of *entamœba coli*. This, as is the case with *Amœbæ muris* of mice, takes place in a cyst, and all these cystic forms correspond exactly with those of *Amœbæ muris* so that it seems probable that *Entamœba coli* is not peculiar to man, but is common to a large number of animals. Exactly similar cysts I have found in the intestinal contents of monkeys. To prove completely a point like this it would be necessary to perform feeding experiments with the encysted forms, but the difficulty of obtaining animals certainly free from amœbæ would render experiments of this description open to criticism.

These observations do not refer to amœbæ of dysentery nor to the disputed point as to whether there is an amœba which can bring about dysentery in man.

In the second place, *Entamœba coli* occurs as well in the healthy as in the unhealthy intestine. In the normal individual it is only possible to discover the encysted forms as in the natural course of events the amœbæ escape from the intestine only in this condition. In cases of simple diarrhœa as also in dysentery large numbers of free forms may be found, these having been driven out from their natural abode in this unprotected state. Amœbæ, either free or encysted, were found in about 60 per cent. of the cases examined.

Trypanosomiasis.

While at Yanfikia I saw three camels suffering from this disease which had been contracted in the Bahr el Ghazal Province. These camels were the sole survivors of seventy-five which had been through the province for transport purposes.

At the same time I also found trypanosomes in a donkey also from the Bahr el Ghazal, and since I have been at Wau I have been able to study trypanosomiasis in cattle, donkeys, and mules.

The trypanosome of camels appears to be distinct from that of other animals. I was only able to study it in stained films, and was unfortunately unable to perform any inoculation experiments so that the difference in the appearance of the trypanosome may be merely due to the difference in host.

In the other domestic animals mentioned above there appear to be two types of trypanosome. The one is allied if not identical with the *Trypanosoma dimorphon* of Dutton and Todd, and described by Dr. Balfour in the Second Report of the Wellcome Research Laboratories. I have encountered this form in donkeys and mules. It appears to be very virulent. The second type differs markedly from the above, being a small trypanosome resembling *Trypanosoma nanum* described in the same report. This form occurs in all these animals. It is less virulent than the dimorphon type, which is easily inoculable into rats, producing an infection in four or five days. The short trypanosome, on the other hand, is difficult to inoculate. In only one rat have I been able to produce an infection, and this after an incubation period of three weeks.

I am conducting experiments with the object of ascertaining if these trypanosomes can be transmitted by the bite of *Glossina palpalis* which occurs in this locality.

I am also attempting the treatment of these animals suffering from trypanosomiasis, but the experiments are not sufficiently advanced to allow of any report being made.

In connection with this subject it may be well to mention that at a point on the Such River, about ten miles south of Wau, where I went with the hopes of obtaining

large numbers of *Glossina morsitans*, in the course of a week I secured about half a dozen specimens of *Glossina palpalis*. The spot at which the floating laboratory was moored was not the most favourable for *Glossina palpalis*, so that had the banks been wooded, which they were not, it is very probable the numbers of *Glossina palpalis* would have been greater.

However, it is certain that south of Wau there exists a large area infected with *Glossina palpalis*. At present, as far as is known, no human trypanosomiasis occurs, but should cases find their way into this district, there is every likelihood that an epidemic of this disease would follow.

Flagellates in Biting Flies.

Large numbers of flies of various kinds have been dissected. These flies belonged chiefly to the tabanidæ and culicidæ. In seven species of tabanus I have found herpetomonas. The herpetomonas in all these forms is probably one and the same. In the different species of tabanus, the number of infected individuals varies greatly, and also the number of any one species infected varies with the locality. Thus, at Tanfikia, about one in every fifty *Tabanus socius* harboured herpetomonas, while at Nassei, on the Sobat, about one in every three. In the cases of some of the other tabanidæ, only a very small percentage of individuals is infected.

The herpetomonas are found usually in the resting stage, and covering almost completely the whole of the gut wall behind the stomach. Into the stomach they seldom extend. Forms with free flagellum and motile, and all intermediate forms between these and resting stages, like the Leishman-Donovan body, occur. In the hindermost part of the gut, forms which appear to be undergoing encystment are found.

Large numbers of mosquitoes were dissected, but only in the intestine of one—*Myzomyia nili*—were herpetomonas encountered.

Malaria.

While at Nassei, on the Sobat, a village surrounded by low-lying marshy land, I attempted to determine the mosquitoes involved in malarial transmission. An examination of the natives (Ainwaks and Newars) showed the widespread nature of malaria amongst these people. In all the children, without exception, of about eight years of age and under, malaria parasites occurred. With increase of age the number of infected individuals diminished till amongst the adults only exceptionally could a malarial parasite be found. The type of malaria, judging from the appearances in the blood, was of the malignant variety. No crescents could be found, nor were any sporulating forms seen in the peripheral blood. While at Nassir all my servants, three Arabs, contracted malaria. In spite of the evident extent of the infection, I was unable to find sporozoites in any mosquitoes though the salivary glands of some hundred anophelinæ were examined.

After this failure I instituted feeding experiments, but the suspicions of the natives brought these to an end.

Blackwater Fever.

At Wau I was able to study a severe case of this disease, which ended fatally in three days. The history of the case favours the malarial theory to some extent. The patient had abstained from quinine for about three months in a most malarious district. Not feeling well one day he took a dose of quinine gr. x. in the evening. During the night he had a severe rigor. I examined his blood early on the following morning, and found a severe malarial infection. About an hour after I had made this examination the patient passed a large quantity of black water. Jaundice, vomiting, hiccough, and finally suppression of urine were prominent features of the case. On the second day all malarial parasites had disappeared from the blood. At the end of the third day the patient died. Neither in the blood or in the centrifuged urine were any organisms other than the malaria parasite found. This case was one in which a condition of depressed vitality was produced by a long-continued malaria infection dependent on an abstinence from quinine. Whether the dose of quinine taken the night before the attack was the exciting cause which brought about the destruction of the infected red corpuscles, or whether there was

some other factor already at work before the quinine was taken, could not, of course, be decided.

New Protozoa.

The blood of large numbers of animals has been examined with the result that in many, new parasitic protozoa have been discovered. These belong to the groups of flagellates, hæmanamœbæ, hæmogregarines, and coccidia.

It is impossible to describe these at present, but they are preserved for description at a later date.

In two reptiles I have found pigmented hæmamœbæ resembling the halteridium of birds. Parasites belonging to this group of hæmosporidia have hitherto been found in cold-blooded animals in only one instance, viz., in the Indian turtle.

Another unpigmented hæmamœba I have found in a lizard in the Bahr el Ghazal. Trypanosomes occur in the monitor, other lizards, snakes, and fish.

In the bristly mouse I have found a trypanosome resembling *Trypanosoma lewisi*. Large forms of this trypanosome occur which are only a little smaller than the large *Trypanosoma theileri* of South African cattle. As in the case of *Trypanosoma lewisi*, the mice are quite unaffected by the presence of this parasite in the blood.

Other Parasites.

I have made a collection of parasitic worms (nematodes, cestodes, trematodes) from various animals.

In the blood of toads filariæ occur, and of these embryos I have secured several specimens of the adult both male and female.

Though I have examined several hundred natives, in only one case have I found filaria embryos in the blood.

This occurred in a man at Wau who had come up from the Belgian country. He was thin and wasted; there was an enormous enlargement of the spleen which extended into the right iliac fossa. A blood count showed the red corpuscles to be normal in number, whereas the white corpuscles were present to the number of 350,000 per cubic millimetre of blood. The vast majority of these white corpuscles (over 96 per cent.) were small mononuclear leucocytes. Filaria embryos were also present to the extent of two or three to each blood preparation. They were blunt-tailed, and had no sheath, so were probably *Filaria perstans*.

In connection with filariæ on the Sobat I found in the thoracic muscles of one mosquito—*Tæniorhynchus tenax*—encysted nematodes resembling filaria embryos. The origin of these I was unable to determine.

Tæniorhynchus tenax fed on toads harbouring filariæ gave no result, as the filaria embryos died in the stomach of the mosquito in the course of two or three days.

Experiments with leeches on the filaria of toads likewise led to no result.

The above report is a more or less incomplete summary of my work during the past six months. It is impossible to state more fully till my material has been subjected to a more careful examination, which it will be impossible to do till after my return to England.

During the past six months one paper has been published on the protozoa inhabiting the intestine of mice. This appeared in a supplementary number of the "Archives für Protistensunde."

C. M. WENYON.

APPENDIX VI.

No. 1.

THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL
OFFICE.

(Received May 1, 1907.)

SIR, B 10, Exchange Buildings, Liverpool, April 30, 1907.
I HAVE the honour to enclose herewith the following reports on the work of the Liverpool School of Tropical Medicine for the six months ending April 30th, 1907, received from the various Departments of the School, on which the Government Grant is expended, viz. :—

- (1) Report of the Walter Myers' Lecturer in Tropical Medicine ;
- (2) Report of the Lecturer in Economic Entomology and Parasitology ; and
- (3) Report of the Director of the Runcorn Research Laboratories.

With regard to the report of the Lecturer in Economic Entomology and Parasitology, I enclose copies of two papers referred to therein, for the information of the Tropical Diseases Advisory Committee, but am to request that they may not be published at present.

I have to point out that in the present year, owing to the Grant to the School having been reduced from £750 to £500, a portion of the Grant previously paid to the Walter Myers' Lecturer in Tropical Medicine has been divided between his Department and the Runcorn Research Laboratories.

I have, &c.,
A. H. MILNE.

Enclosure 1 in No. 1 in Appendix VI.

The Incorporated Liverpool School of Tropical Medicine,
The University, Liverpool, April 30, 1907.

SIR, I BEG to submit the following report on the work done during the period from November 1st, 1906, to April 30th, 1907.

DIPLOMA IN TROPICAL MEDICINE.

The number of candidates who entered for the examination in December, 1906, was six, of whom six passed. The number of candidates who entered for the examination in March, 1907, was nine, of whom six passed.

THE PERIOD OF STUDY.

While these numbers show the work done by the candidates is good, yet I must again point out that, owing to the limited time for teaching, the number of subjects and the extent to which each is pursued is also limited, and they are not of that comprehensive character which I consider a Diploma should require. In fact, as I have previously urged, the standard of the Diploma should be raised, and based on a six months' course of work. The question of time is a difficulty, but it is one that must be overcome, and must not be allowed to produce a lower standard of expert knowledge and training, as is now the case. When it is considered that some of the medical men attending the tropical school, are completely ignorant of bacteriology, it is evident that more than three months are required to impart the elements of this subject, dealing, as it does, with such important diseases, to mention three only, as Plague, Cholera, and Dysentery.

If, further, we consider that a fundamental knowledge of the methods and facts of parasitology, including, as it does, such diseases as Malaria, Trypanosomiasis, and Spirochæte diseases—and a considerable amount of Helminthology and Entomology, in their relations to disease, have also to be grappled with in three months,

then I think that the need for the establishment, at least for the more advanced class of medical men, of a six months' course is evident. In view, too, of the suggestion, made in the Earl of Elgin's circular to the Governors, dated 23rd April, 1906, "that some members of the practising medical staff of a colony shall, at stated intervals, be deputed to bring back to the Colony and directly into the medical work of the Colony, the latest results of the most highly organised scientific research," I consider that the establishment of a six months' course, embracing subjects now neglected, and giving those attending it opportunity for research and acquaintance with the methods of research, is immediately necessary.

The medical men attending the courses are always extremely anxious, without exception, to learn all they possibly can in the time, and I gather from them that they all regard three months as insufficient, considering the extent of the subject, and especially the fact that much of the work is entirely of a new kind, and such as previously they have had no experience of. Among the medical men attending the School, there are many who would be quite fit to occupy bacteriological and similar posts, if their training were extended. The services of many of the men, who show keenness, initiative, and power of judgment, are now, I think, lost for purposes of research, owing to their incomplete training. I have thought fit to make these comments, which perhaps are not purely my concern, because among the Colonial Officers attending the course there is much good material. If I may venture to express an opinion, the Colonial Medical Service should rely on its own officers for supplying suitable men for bacteriological and other posts, which I believe, are in course of formation; and that Service is quite capable of finding suitable men, if it afforded the medical officers under training the time and opportunity for acquiring the necessary knowledge.

ANNALS OF TROPICAL MEDICINE AND PARASITOLOGY.

It may not be out of place here to mention that the Committee of the School recently decided to change the manner of issue of the Memoirs of the Liverpool School of Tropical Medicine. Hitherto the work done by the School has been issued in the form of special Memoirs, of which twenty-one have been already issued. These memoirs, or reports, although containing what the School believes to be very valuable material, have a somewhat limited circulation, mainly, no doubt, owing to their expense, and to the fact that they contain exclusively work of the Liverpool School. The Committee considered that there was need for a Standard Journal on Tropical Medicine and Parasitology, where articles, that now appeared in ordinary medical journals, might, if of sufficiently high standard, be published, and so be gathered together and be of greater use to students of tropical medicine. It was, therefore, decided to enlarge the sphere of our reports and under the editorship of Professor Major Ross, C.B., F.R.S., and a Committee, the first number of the "Annals of Tropical Medicine and Parasitology" was published last February. The "Annals" are open to anybody, provided only that the contributions are thought worthy of insertion. The editors were especially fortunate in securing for the first number of the "Annals" papers by authors so distinguished in their respective subjects as Professor Neumann, who contributed a paper on a "Description of two new species of African Ticks," and also Professor Looss, who wrote on "Some Parasites in the Museum of the School of Tropical Medicine, Liverpool."

The first number of the "Annals" also contains a valuable description by Mr. Newstead of the specimens collected in the Congo by the members of the Expedition of the School.

It is hoped that a high standard of publication on tropical medicine will be maintained and that support will be forthcoming from all interested in tropical medicine and parasitology.

RESEARCH WORK.

In conjunction with the Lecturer on Economic Entomology, Mr. R. Newstead, I have undertaken the study of the anatomy of the proboscis of *Stomoxys Calcitrans*. This fly, or an allied species, is almost undoubtedly the disseminator of trypanosome diseases in various tropical regions, and hence its economic importance is great. We had anticipated from our previous study of the anatomy of the proboscis of the tsetse fly that this species of work would be comparatively simple. On the contrary we found ourselves confronted by so many unforeseen difficulties that personally I decided to postpone all other research work in order to complete this. Unlike that

of *Glossina*, the proboscis of *Stomoxys* is an opaque black structure, and so not easily examined by transmitted light. It is also a much harder, and a more formidable weapon than that of *Glossina*, and so is still more difficult to cut with the microtome. But these difficulties were eventually overcome and excellent preparations procured. So extraordinarily complex, however, is the structure, that we found that it was necessary, in order to understand the arrangement, to construct models of each section cut, and then, by placing them together, to refashion on a very large scale the whole proboscis. We hope that we have been able to make quite clear the nature of the apparatus by which this biting fly pierces the skin. The cutting apparatus here does not consist, as in the mosquito, of two pairs of fine saws, or as in *Glossina* of fine rasp-like structures aided by a few teeth, but, here, there are five large, powerful, serrated, chitinous teeth on each side, placed internally and consequently incapable of coming into play, until these structures are everted. It is by a rotatory to-and-fro motion, imparted to these when everted, that the skin is pierced, much as a bradawl pierces a piece of wood. The whole proboscis, as in the tsetse fly, can be inserted in the skin. It will be interesting to see how far this arrangement is followed in other biting flies. This paper is now in the printer's hands, and will appear forthwith in Vol. 1, No. 2, of the "Annals of Tropical Medicine and Parasitology." It is illustrated by eight plates comprising numerous figures.

SPECIMENS RECEIVED.

Valuable specimens have during the past year been received from:—

Major Sharman, I.M.S.; Dr. F. Arnold, Pretoria; Dr. C. F. Watson, Nigeria; Dr. Lyndogh, Assam; Captain Dee, I.M.S., Burma; Dr. Renner, Freetown; Dr. Bate, Nigeria; Captain Maddock, I.M.S., India; Dr. Muat, Wei-hai-wei; Dr. Elkington, Tasmania; Dr. Bruce, Soudan; Dr. Agramonte, Havana; Major Robertson Milne, I.M.S., Calcutta.

I desire to express my sincere thanks to these medical men for their valuable help.

I have, &c.,

J. W. W. STEPHENS,

Walter Myers' Lecturer in Tropical Medicine.

The Secretary,

The Liverpool School of Tropical Medicine,
B 10, Exchange Buildings,
Liverpool.

Enclosure 2 in No. 1 in Appendix VI.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE.

DEPARTMENT OF ECONOMIC ENTOMOLOGY AND PARASITOLOGY.

SIR,

I HAVE the honour to submit my half-yearly report as Lecturer in this department of the Liverpool School of Tropical Medicine. The work comprises the following subjects:—

LECTURES AND DEMONSTRATIONS.

The usual number of practical lectures were given during the terms October to December, 1906, and January to March, 1907; but owing to the shortness of the terms and the enormous increase in the number of pathogenic animals, it was found quite impossible to deal with the subject as fully as could be desired, and several important animals were left practically untouched. This, one need scarcely point out, is a very serious omission, and can only be remedied by extending the course or increasing the number of lectures and demonstrations in each term. So far it has been impossible to arrange for any extra lectures on the Pathogenic Arthropoda without reducing the work in other departments of tropical medicine.

The number of medical and veterinary students who have attended the lectures during the last half year is as follows:—

From October to December, 1906	...	...	...	...	13
From January to March, 1907	...	...	...	...	18
					—
Total	...	...	...	...	31
					—

SYLLABUS OF THE COURSE.

(1) *Crustacea*.—*Entomostraca*: Living examples of Cyclops as the intermediary host of the guinea-worm (*Filaria medinensis*). Differential characters, life-cycle, distribution, &c.

(2) *Ixodidæ* (Ticks).—External and internal anatomy, characters and classification. Life-cycle, habits, distribution and specific characters of *Ornithodoros moubata*, *Argas persicus*, *A. reflexus*, and all the species concerned in the transmission of Piroplasmosis in the domestic animals. All the species are available for demonstration, and at least three of the more important ones have been kept alive in the laboratory so that the metamorphosis could be studied fully and the students thoroughly acquainted with the living forms.

(3) *Acariasis*.—The various species of acarids producing this disease in man and the domestic animals are dealt with as fully as time permits.

(4) *Culicidæ* (mosquitoes).—General characteristics of the family. Anatomy, classification. Characters of the sub-families and important genera. Habits, distribution and life cycle of the Anophelina, Culicina, &c. The museum contains an excellent collection of these insects, and living larvæ and pupæ of Anopheles and Culex are, when in season, always available for study in the laboratory. In the winter term of last year living examples of the yellow fever mosquito (*Stegomyia fasciata*), in all stages, were reared in the laboratory from ova supplied by Dr. H. Wolferstan Thomas in South America.

(5) *Simulidæ* (Sand flies) and the blood-sucking midges of the genus *Ceratopogon* and *Phlebotomus*.

(6) *Muscidæ*: Tsetse flies of the genus *Glossina*. Several lectures are devoted to a complete study of the bionomics of these important flies. All the species but one are available for study, including also the larvæ and pupæ of *Glossina palpalis* and *G. fusca*, and we also possess an abundance of material for demonstration purposes.

Other important members of the Muscidæ treated of are the stable flies (*Stomoxys spp.*) *Lyperosia spp.* The Congo floor maggot (*Auchmeromyia luteola*) and the house fly (*Musca domestica*) and its allies (*Pycnosoma spp.*), and also the several species producing myiasis in man and the domestic animals.

(7) *Hemiptera*.—The bed bugs (*Cimex spp.*) and the suctorial lice. The biting lice of cattle (*Mallophaga*), &c., are also treated of in the Veterinary Department.

(8) *Tabanidæ*.—The three important genera: *Tabanus*, *Chrysops* and *Hæmatopota*. These are studied chiefly by the students of the Veterinary Department; and as far as time permits also by the medical students.

(9) *Æstridæ*.—The Ox warble flies and bot flies.

(10) *Hippoboscidæ*.—The Forest flies and their allies, e.g., *Melophagus*, &c.

(11) *Aphaniptera* (Fleas).—The general characteristics and habits of these insects are given, special reference being made to the species (*Pulex cheopis*) concerned in the dissemination of plague.

(12) *Linguatulidæ* (Tongue worms).—Characteristics and metamorphoses.

(13) The methods of collecting and preserving insects, ticks, &c., and the necessary preparation of these animals for microscopical examination are practised in the laboratory.

LECTURES ON ECONOMIC ENTOMOLOGY.

Two courses of lectures were given to the veterinary undergraduates attending the Zoology course in the University.

DETERMINATION OF BLOOD-SUCKING INSECTS AND TICKS.

The work in this section of my department is rapidly increasing. Among the numerous specimens submitted by former students of this school and other correspondents are two new blood-sucking flies: (1) A new *Anopheline* of the genus *Cellia* collected by Dr. F. Arnold, of Pretoria, South Africa; and (2) A new species of *Chrysops* sent in by Dr. R. H. Kennan, of Accra. These insects will be described in the "Annals" of this School.

DETERMINATION OF EXOTIC INSECTS INJURIOUS TO ECONOMIC PLANTS, GRAIN, &c.

The work in this department has been very heavy during the last half-year. Among the more important questions, those concerned in the weevilling of stored grain has occupied considerable attention. A report and expert evidence was given in the case of two cargoes of weevilled grain from Australia, in which the percentage of damaged grain (wheat) worked out at 19.0 and 22.5 per cent., respectively. The African Trade Section of the Chamber of Commerce, Liverpool, has also been furnished, at the request of Viscount Mountmorres, with a short report on the habits of the corn weevils (*Calandra oryzae* and *C. granaria*) with notes on the best known methods of prevention and destruction of these pests. A copy of this report* is submitted herewith.

A supplementary list of the injurious scale insects (*Coccidæ*) found living in the Royal Botanic Gardens, Kew, England, has been prepared, and is published in the "Kew Bulletin." This paper also gives notes on the geographical distribution of the insects, together with a list of the food plants (see copy of "Bulletin" submitted herewith, Article XXI, pp. 97-100, 1907).

PAPERS PUBLISHED.

(A) Insects and other Arthropoda collected in the Congo Free State. "Annals of Tropical Medicine and Parasitology," Vol. I, No. 1, pp. 1-114. Plates I-VI, figures in the text 1-20 (joint with Dr. J. L. Todd and the late Dr. J. Everett Dutton). A copy of the author's reprint is submitted herewith. It will be seen that the work extends to 114 pages, and embraces 109 separate illustrations, all from original drawings and photographs prepared by myself. There are also two maps prepared by my colleague, Dr. Todd. This work deals with the following subjects:—

- (1) An introduction in which the route followed by the members of the expedition is given, accompanied by a map and full data.
- (2) The mosquitoes (*Culicidæ*): 46 species and varieties are dealt with, including two new genera, 12 new species and two new varieties. The habitats of each species are given in full, thus our knowledge of the distribution of the African *Culicidæ* is much widened.
- (3) Brief records of the occurrence of the small blood-sucking midges (*Chironomidæ* and *Psychodidæ*) and some important notes on the structural characters and habits of the larva of a species of sand-fly (*Simulium*).
- (4) Records of the occurrence and distribution of some 20 species of *Tabanidæ* (Horse Flies, &c), including three species new to science.
- (5) Detailed description of the structural characters (mouth parts, &c.) of the Congo Floor Maggot (*Auchmeromyia luteola*), together with notes on its geographical distribution and general bionomics.
- (6) Other species of *Muscidæ* observed.
- (7) On the bionomics of the tsetse flies (*Glossina*) and the description of a species (*Gl. maculata*, Newst.) new to science. The subjects dealt with under this heading are: (a) A long list of native names; (b) distribution of the various species met with, illustrated by a map; (c) extensive field notes in which some important matter dealing with the habits of these flies are set forth by my colleagues; (d) description of the larva and pupa of *Gl. palpalis* and *Gl. fusca*; (e) catalogue of the species observed.
- (8) On the stable flies of the Genus *Stomoxys*, including a reprint of my

* Not printed.

paper on the Life-history of *Stomoxys calcitrans*; and the description of a species new to science.

- (9) Three cases of myiasis, one in man and two in mammals.
- (10) Forest flies (*Hippoboscidae*): with a description of a new species of *Lipoptena*.
- (11) Miscellaneous orders of the insecta.
- (12) *Ixodidae*.—Notes on the occurrence of thirteen species and varieties of ticks taken from cattle and wild mammals. Professor Neumann has described the two new species discovered by the members of the expedition (*vide* "Annals of Tropical Medicine and Parasitology," pp. 113-121).

PAPERS COMPLETED BUT AWAITING PUBLICATION.

(B) Summary of the Life-history of *Stomoxys Calcitrans*. By request of Colonel D. Bruce, R.A.M.C., C.B., for publication in the Journal of the Royal Army Medical Corps.

(C) On the Anatomy of the Proboscis of *Stomoxys*: Joint with Dr. J. W. W. Stephens. My colleague has already referred to the work in connection with the preparation of this paper (*vide* report of Walter Myers' Lecturer). It remains for me to emphasise the fact that this subject has involved a considerable amount of time and labour; but we have been able to clear up many important discrepancies.

PAPERS IN COURSE OF PREPARATION.

Report on the Injurious Insects of the West Coast of Africa. I have previously referred to this work; but regret that owing to other pressing matters this report has not yet been completed.

RESEARCH WORK AND INVESTIGATIONS.

1. The bionomics of the Texas Fever Tick plus *Rhipicephalus* (*Boophilus*) *annulatus*.

2. A Report on the Plankton or Animal and Vegetable Organisms found in the reservoirs of the Liverpool Corporation has just been completed, and the result of the examinations of 76 samples of water are embodied in it. A copy of my report* is submitted herewith.

3. I have to report that by the request of Professor Ross, C.B., F.R.S., and Dr. E. W. Hope, the Medical Officer of Health for Liverpool, I have undertaken to investigate the bionomics of the House Fly and its allies, with special reference to these insects as being the possible carriers of disease. This work will be carried on chiefly during the vacations of this School, and a period of three weeks has already been devoted to this investigation.

I have, &c.,

ROBERT NEWSTEAD,
Associate of the Linnean Society, &c.,
Lecturer in Economic Entomology and Parasitology.

The Secretary,
Liverpool School of Tropical Medicine,
B 10, Exchange Buildings,
Liverpool.

Enclosure 3 in No. 1 in Appendix VI.

The Incorporated Liverpool School of Tropical Medicine,

As requested, I have the honour to report briefly on the research work that has been carried out at the Research Laboratories of the Liverpool School of Tropical Medicine at Runcorn, during the six months ending 30th April, 1907.

In view of the large number of experiments conducted there, and of strains of parasites maintained, it is impossible with the space at my disposal to enter into details.

The following have worked at the laboratories during the period named, viz.,

* Not printed.

Dr. J. L. Todd, Director; Dr. Breinl, Assistant Lecturer; Dr. Allan Kinghorn; Dr. E. Tobey; Dr. Hanington; and four specially trained laboratory assistants.

Some of the results of their work are contained in the following publications issued from the laboratories, or about to be issued:—

1. Breinl and Todd. "Atoxyl in the Treatment of Trypanosomiasis." "British Medical Journal," January 19th, 1907.

The beneficial action of Atoxyl on trypanosomiasis was discovered by Thomas and Breinl in these laboratories. The present paper reviews our knowledge of its action and indicates the method in which it is thought it can best be exhibited in human trypanosomiasis.

2. Kinghorn and Todd. "Review of the Present Means of Combating Sleeping Sickness." "The Lancet," February 2nd, 1907.

Sleeping Sickness is caused by a trypanosome which is transmitted by a biting fly (*Glossina palpalis*). Prophylactic measures may be directed against either the parasite or the fly. This paper discusses the way in which such measures may best be applied.

3. Dutton, Todd and Tobey. "Trypanosomes of the Trumpeter Hornbill (*Bycanistes Buccinator*)." "Journal of Medical Research," Volume XVI, No. I, March, 1907.

This paper describes an unidentified and probably new trypanosome of birds.

4. Dutton, Todd and Tobey. "Concerning Hemoflagellates of An African Fish" (*Clarias Angolensis*). "Journal of Medical Research," Volume XV, No. 3, December, 1906.

This paper describes an unidentified trypanosome and a new spirochæte in fish.

5. Newstead, Dutton and Todd. "Insects and Other Arthropoda collected in the Congo Free State." "Annals of Tropical Medicine and Parasitology," Vol. I, No. I.

This paper was partly prepared at the Runcorn laboratories. It is an extensive study of insects and ticks, collected in the Congo Free State, which attack men or animals. The distribution of the various species is carefully given. Many new genera and species of mosquitoes, biting flies and ticks are described. Among them is a new Tsetse Fly and two new ticks. Many interesting observations on the bionomics of the Arthropoda are described; it is superfluous to insist on the importance of such studies to tropical medicine.

6. Moore, Nierenstein and Todd. "A Note on the Therapeutics of Trypanosomiasis."

This paper is a preliminary communication of the beneficial results which have been obtained by the combined treatment with atoxyl and mercury in rats infected with *Trypanosoma brucei*. It was published with the object of inducing physicians, who had an opportunity, to treat human cases along these lines. In this work the Bio-Chemical Laboratory of the University of Liverpool has collaborated with the Runcorn laboratories.

7. Carter. "The Presence of *Spirochaeta duttoni* in the ova of *Ornithodoros moubata*." "Annals of Tropical Medicine and Parasitology, Vol. I, No. I.

In this paper multiplication and important changes in form are described in *Spirochaeta duttoni* from eggs laid by infected ticks.

8. Moore and Breinl. "Development of trypanosomes in vertebrate hosts."

This is a most important paper in which the Cancer Research Laboratory of the University of Liverpool has collaborated with the Runcorn laboratories.

9. Dutton, Todd and Tobey. The continuation of a paper commenced in Memoir XXI on "Parasitic Protozoa observed in Africa."

Stages in the development of a *Leucocytozoon* of birds are described in this paper. An important cycle of development in frog trypanosomes and other protozoa in birds, tortoises, snakes, crocodiles, tsetse flies and mosquitoes are also described. The study of these parasites was undertaken because of the analogy existing between them and certain parasites infecting man and other animals.

10. Dutton, Todd and Hanington. "Trypanosome Transmission Experiments."

This paper presents the results of the experiments done in the Congo on the transmission of various trypanosomes by the bites of tsetse flies and other biting insects.

11. Dutton, Todd and Kinghorn. "Cattle Trypanosomiasis in the Congo Free State."

This paper describes the distribution of trypanosomiasis in domestic animals and game in the Congo Free State. It describes and identifies several parasites obtained from cattle, horses and antelopes.

12. Moore, Nierenstein and Todd. "Concerning the Therapeutics of Trypanosomiasis." (Produced in collaboration with the Bio chemical laboratories, University of Liverpool.)

This is a continuation of the note published in No. I of the "Annals of Tropical Medicine and Parasitology." It is found that combined treatment of animals infected with Nagana by atoxyl and mercury is much superior to treatment by atoxyl alone.

13. A preliminary note on the Development of *Spirochæta duttoni* in *Ornithodoros moubata* is also in preparation.

In addition to these various publications which have already appeared or are about to appear, six different species of trypanosomes and three of spirochætes have been constantly maintained at the laboratory for teaching purposes. Work on the development of *Spirochæta duttoni* in *Ornithodoros* and on the bionomics of *Ornithodoros* itself has been steadily carried out. Spirochætes and bed bugs were obtained from Moscow, where an epidemic of relapsing fever has occurred during this winter, for the purpose of experimenting on the possible part which bed bugs may play in causing epidemics in this disease.

The negotiations and preparations preliminary to the despatch of the important expedition about to go out from our School for the purpose of studying the means of preventing the spread of Sleeping Sickness, have all been carried out from this laboratory.

I am, &c.,

J. L. TODD,

Director of Research Laboratories,
Runcorn.

The Secretary,

The Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings,
Liverpool.

No. 2 in Appendix VI.

THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL
OFFICE.

(Received November 11, 1907.)

SIR,

B 10, Exchange Buildings, Liverpool, November 9, 1907.

WITH reference to the expenditure of the Government grant allocated to the Liverpool School of Tropical Medicine, I have the honour to enclose the reports of the Walter Myers' Lecturer in Tropical Medicine, the Lecturer in Economic Entomology and Parasitology, and the Director of the Runcorn Research Laboratories of the School, on the work of the School from the 1st of last May to 31st October.

I am to say that the reports mainly deal with work which has been assisted by the Government grant in question. They do not deal with the whole work of the School in detail.

I beg to point out, for the information of His Majesty's Government, that at the present moment the School are financing the following three expeditions, viz.: (1) Yellow Fever Expedition in Manaos and the Amazon; (2) Blackwater Fever Expedition in Central Africa; and (3) Sleeping Sickness Expedition in Rhodesia. They have also lent the services of the Professor of Tropical Medicine to the Government of Mauritius, for the purpose of investigating the prevalence of malaria, and other diseases, there. The School have also raised considerable funds for the following purposes, viz.: (1) The Anti-Malaria League of Greece; (2) Establishment of a Professorship in Entomology and Parasitology in memory of the late Dr. Dutton; (3) Establishment of a permanent Lectureship in the Liverpool School of Tropical Medicine in memory of the late Dr. Walter Myers; (4) Despatch of, and expenditure on, the three research Expeditions named above.

I enclose copy of the pamphlet* referred to in the Report of the Economic Entomologist and Parasitologist, as at foot, and of Part II. of the "Annals of Tropical Medicine and Parasitology,"* referred to in the Report of the Walter Myers' Lecturer in Tropical Medicine.

I am, &c.,
A. H. MILNE,
Secretary.

ENCLOSURES.

1. Report of the Walter Myers' Lecturer in Tropical Medicine.
 2. Report of the Lecturer in Economic Entomology and Parasitology.
 3. Report of the Director of the Runcorn Research Laboratories of the School.
 4. Part II., "Annals of Tropical Medicine and Parasitology."
 5. "The Anatomy of the Proboscis of Biting Flies," Part II.
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1.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE.

REPORT OF THE WALTER MYERS' LECTURER OF THE SCHOOL.

SIR,

I BEG to submit the following report on the work done during the period from April 1st to October 31st, 1907.

Diploma of Tropical Medicine.

The number of candidates who entered for the examination in July, 1907, was 10, all of whom were successful.

Entries for the Autumn Term.

The number of students who have entered for this term is seven.

Period of Study.

In view of the apparent difficulties of extending the period of study to that of a six months' course of work, the proposal to that effect has for the time being been abandoned; but so urgently is extra time needed for teaching the large number of subjects embraced by tropical medicine that it has been decided by the various committees and faculties regulating medical studies in the medical school and the university, that the term should be extended by three weeks, making the term a real three months and not a nominal one as at present. It has accordingly been arranged to have two terms of three months (13 or 14 weeks) each, and a short summer course of one month. It is felt that the extension of the term by three weeks will be a distinct gain, both for those engaged in teaching and to those taught.

Annals of Tropical Medicine and Parasitology.

The second part of this volume (pages 162-284) was issued in June last (copy enclosed herewith). It contains the following articles:—

- An Automatic Oiler for the Destruction and Prevention of Mosquito Larvæ in Cesspools and other collections of water, by E. H. Ross and H. C. Ross.
- The Anatomy of the Proboscis of Biting Flies, Part II., *Stomoxys*, by Dr. J. W. W. Stephens and R. Newstead.
- Trypanosome Transmission Experiments, by Dr. J. E. Dutton, Dr. J. L. Todd, and Dr. J. W. B. Hanington.
- Cattle Trypanosomiasis in the Congo Free State, by Dr. J. E. Dutton, Dr. J. L. Todd, and Dr. A. Kinghorn.
- Concerning the Treatment of Experimental Trypanosomiasis, by Professor Benj. Moore, Dr. M. Nierenstein, and Dr. J. L. Todd.

* Not reprinted.

The following papers will be published in the third number of the annals and will appear early in November:—

Concerning certain Parasitic Protozoa in Africa, by Dr. J. E. Dutton, Dr. J. L. Todd, and Dr. E. N. Tobey.

Yaws, by Dr. C. W. Branch.

A description of some Gold Coast Entomostraca, by Dr. W. M. Graham.

Notes on Dr. Graham's collection of Cyclopidae from the African Gold Coast, by Dr. G. S. Brady.

On the Morphology and Life History of *Spirochaeta duttoni*, by Dr. A. Breinl.

The Cytology of the Trypanosomes, by Professor J. E. Salvin-Moore and Dr. A. Breinl.

Research Work.

The paper in connection with Mr. Newstead on the Anatomy of the Proboscis of Biting Flies was completed and published in No. 2 of the Annals.

During the absence of the Professor of Tropical Medicine (Major R. Ross), the duties of the professor have devolved on myself, and, consequently, I fear that there will be little time left at my disposal for research work.

The Museum.

The thanks of the School are due to the following gentlemen for specimens sent to the School during the last six months:—

Dr. A. Pickels, Nigeria; Dr. A. Bremner, Nigeria; Captain Patton, I.M.S., Madras; Professor N. Surveyor, Bombay; Dr. Irwin Taylor, Gold Coast; Dr. Arnold, Pretoria; Captain Maddock, I.M.S., India; Dr. Ian Macdonald, Huelva; Dr. Renner, Freetown; Dr. Kennan, Freetown; Dr. Hunter, Freetown; Captain Christophers, I.M.S., Madras; Dr. Williamson, Cyprus; Dr. A. B. Duprey, Trinidad; and Captain W. H. Kenrick, I.M.S., India.

I have, &c.,
J. W. W. STEPHENS.

The Secretary,
Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

2.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE.

DEPARTMENT OF ECONOMIC ENTOMOLOGY AND PARASITOLOGY.

SIR,

I HAVE the honour to submit my half-yearly report as Lecturer in this Department of the Liverpool School of Tropical Medicine.

Lectures and Demonstrations.

The number of medical candidates who attended the Lent term was 13.

The number of veterinary candidates was 4.

The number of entries for the autumn term was 7 for tropical medicine and 3 for veterinary pathology.

A course of lectures was also given to the veterinary undergraduates attending the zoology course in the university.

Papers Published.

(1) The Anatomy of the Proboscis of Biting Flies, Part II., *Stomoxys* (Stable Flies), joint with Dr. J. W. W. Stephens. *With 8 plates.* This paper was published in the Annals of Tropical Medicine and Parasitology. Dr. Stephens, my colleague, has already referred to this paper at some length in his last report to the Colonial Office so that further comment is unnecessary. A copy of the reprint of this paper is submitted herewith.

(2) Preliminary Report on the Habits, Life Cycle, and Breeding Places of the Common House Fly (*Musca domestica*), as observed in the City of Liverpool, with suggestions as to the best means of checking its increase. Ordered by the

Health Committee to be printed, 3rd October, 1907. Town Clerk's Office, Liverpool. Pp. 23, 14 illustrations.

This investigation was conducted chiefly with the view of ascertaining the nature and extent of the breeding places of the common house fly and also the period of the life-cycle of the fly under varying atmospheric and other conditions, so that some practical measures might be devised for the destruction of this pest.

Altogether, the refuse from over 300 ashpits and bins (chiefly the former) was examined and 37 middensteads carefully inspected. Human excreta found in the courts and passages was also inspected and breeding-cage experiments with this and the excreta of domesticated animals were also conducted. The survey was restricted to five areas in different parts of the city, embracing in all visits to 68 streets.

In this report I have endeavoured to show that:—

- I. The chief breeding places of the house fly are:—
 - (a) Stable middens containing fermenting horse manure or a mixture of this and cow dung;
 - (b) Middens containing fermenting spent hops; and
 - (c) Ashpits containing fermenting vegetable matter, or about 25 per cent. of the total number of pits examined.
- II. That covered ashpits and middens were as badly infested as those which were open.
- III. That house flies breed in all temporary collections of fermenting matters.
- IV. That house flies breed in relatively small numbers in ashpits where no fermentation takes place.
- V. That they do not breed in ashpits which are emptied at short intervals or in the patent bins.
- VI. That the use of disinfectants in ashpits do not prevent the flies breeding in such receptacles.
- VII. That very dry or excessively wet ashes and moist cow dung does not harbour them.
- VIII. That the presence of fowls (not ducks or geese) which had free access to the stable middens reduced the number of larvæ and pupæ to a very marked extent.
- IX. That the life-cycle of the fly, in all kinds of fermenting materials, is reduced to the minimum period of 10 to 14 days; and that in the absence of such artificial heat the cycle may occupy a period of from three to five weeks or more, according to the temperature of the outside air.
- X. That house flies do not depend entirely upon excessively warm weather for breeding purposes, though in hot seasons they would breed much more rapidly in non-fermenting materials, and their numbers, under such conditions, would be greatly increased.

The application of Paris green (poison) at the rate of 2 ozs. to the gallon of water to either stable manure or ashpit refuse will destroy 99 per cent. of the larvæ. Possibly a smaller percentage of Paris green might be employed with equally good results.

One per cent. of crude atoxyl in water kills 100 per cent. of fly larvæ.

The application of either of these substances might, however, lead to serious complications, and it is very doubtful whether they could be employed with safety. Paris green, at the rate of 1 to 2 ozs. to 20 gallons of water, is used largely as an insecticide for fruit pests. It does no harm to vegetation when applied in small quantities; but cattle might be tempted to eat the dirty straw in manure which had been treated with this substance, and the results might prove fatal if large quantities were eaten.

In view of the important part which house flies are claimed to play in the dissemination of certain zymotic diseases, more especially that of typhoid epidemics in the tropics, it is intended that the Report shall be reprinted in the Annals issued from this School so that the subject may receive wider publicity and thereby be of some service to the medical student in the tropics.

*Determination of Exotic Insects injurious to Economic Plants, &c.**Mosquitoes and other Biting Flies, &c.*

Collections of insects from the Transvaal, West Coast of Africa, Cameroons, Java, and Madagascar have been identified since the last report was submitted, and a short Report on these collections is in the course of preparation for publication.

A short Report on various forms of animal life found in the water-mains of the City of Liverpool has been furnished to the Chief Engineer.

I have, &c.,

ROBT. NEWSTEAD,

Lecturer in Economic Entomology and Parasitology.

The Secretary,
Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

3.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE.

DEPARTMENT OF THE DIRECTOR OF THE TROPICAL RESEARCH LABORATORIES, RUNCORN.

SIR,

IN compliance with your request, I beg to report on the manner in which the special Government grant-in-aid for research work on trypanosomiasis has been expended during the period ranging from May 1st to October 1st of this year.

The money was utilised in assisting the current expenses of the laboratory, particularly in the purchase and the maintenance of experimental animals.

The main lines on which the work was conducted during this period are:—A continuation of the research work on sleeping sickness and on cattle trypanosomiasis, which has been carried on in this laboratory for the last three years, and other researches, of which mention is made below:—

I. The work commenced by Professor Benj. Moore, Dr. M. Nierenstein, and Dr. J. L. Todd on the efficacy of the treatment of trypanosomiasis by the combination of atoxyl and mercury has been continued.

II. Further studies have been made on the morphology of *Trypanosoma gambiense* by Professor J. E. Salvin-Moore and Dr. Anton Breinl. They have been able, with the aid of new methods, to show that *Trypanosoma gambiense*, the parasite of sleeping sickness, undergoes a complete life-history in experimental animals.

III. Researches on the morphology of spirochætes have been made by Dr. Breinl and the results of the work have been published.

IV. Dr. Hanington has worked with various cattle trypanosomes, brought back from the Congo Expedition, and has demonstrated through cross immunity that the strain described by Dutton, Todd, and Kinghorn as "Toul" is not identical with *Trypanosoma dimorphon*.

V. Dr. J. J. van Loghem, Arts, Privaat Docent aan de Universiteit van Amsterdam, worked in this laboratory for two months on the morphology of spirochætes in sections of organs. The results of his studies will be published in a paper entitled: "Some Notes on the Morphology of *Spirochæte duttoni* in the Organs of Rats."

VI. Professor R. O. Neumann also worked in this laboratory on the formation of precipitines in trypanosome infection before and after the use of atoxyl.

The following is a list of those who have worked in these laboratories during the last six months:—

Dr. M. Nierenstein (International Fellow).
Dr. J. W. B. Hanington.
Dr. J. J. van Loghem.
Professor R. O. Neumann.
Dr. A. Breinl (Director).

The following is a list of the publications issued since May 1st from these laboratories:—

Note on the Life-cycle of the Parasite of Sleeping Sickness, by Professor J. E. Salvin-Moore and Dr. Breinl. "Lancet," 4th May, 1907.

The Treatment of Trypanosomiasis, by Dr. M. Nierenstein. "Lancet," 27th July, 1907.

Concerning the Treatment of Experimental Trypanosomiasis, by Professor Benj. Moore, Dr. M. Nierenstein, and Dr. J. L. Todd.

Annals of Tropical Medicine and Parasitology. No. 2. June, 1907.

Concerning certain parasitic protozoa observed in Africa, by the late Dr. J. E. Dutton, Dr. J. L. Todd, and Dr. E. N. Tobey.

Annals of Tropical Medicine and Parasitology. No. 2. June, 1907.

Cattle trypanosomiasis in the Congo Free State, by the late Dr. J. E. Dutton, Dr. J. L. Todd, and Dr. Allan Kinghorn.

Annals of Tropical Medicine and Parasitology. No. 2. June, 1907.

I am, &c.,

ANTON BREINL.

The Secretary,
Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

APPENDIX VII.

No. 1 in Appendix VII.

BRITISH GUIANA.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received April 15, 1907.)

MY LORD, Government House, Georgetown, Demerara, March 19, 1907.

I HAVE the honour to transmit a report by Dr. K. S. Wise, Government Bacteriologist, on the work done in connection with tropical diseases research, in the Bacteriological Laboratory of this Colony, during the six months ended 31st December, 1906. The next report will include the period from the 1st January to the 30th September and the periods named in your Lordship's despatch will afterwards be followed.

I have, &c.,
F. M. HODGSON.

Enclosure in No. 1 in Appendix VII.

Public Hospital, Georgetown, March 7, 1907.

REPORT on Work done in connection with Tropical Diseases Research in the Bacteriological Laboratory of British Guiana during the Six Months ending December 31, 1906.

1. *Acute Anæmia.*

Between 1903 and 1905 Dr. C. P. Kennard, Government Medical Officer of this Colony, drew the attention of the medical profession to a condition of profound anæmia, often associated with pregnancy, but also occurring not infrequently in men and in women apart from pregnancy. The anæmia is severe, completely incapacitates from work, and after ends fatally in spite of active treatment.

The disease, I am assured by medical officers who are in a position to judge, is very common on the sugar estates of this Colony, represents a serious factor in the statistics of admission to their hospitals, and shows an unwelcome return in the mortality amongst East Indians. Patients admitted to the Public Hospital, Georgetown, have been carefully examined with regard to this disease, and amongst them 11 fatal cases have come to my notice and were examined in the Bacteriological Laboratory. These 11 cases were chemically and bacteriologically examined during life and a thorough autopsy formed after death, with subsequent microscopical examination. These 11 cases comprised 1·96 per cent of the total number of post-mortem examinations performed during that period.

The 11 cases comprise 6 males and 5 females, of which four were associated with pregnancy.

Seven were of East Indian race, born in East India; one was of East Indian race, born in British Guiana; and three were of the black race and born in British Guiana.

The symptoms of the patients are summarised below and form a very typical symptom complex, which is readily recognisable when attention has once been drawn to it.

The age varied from 18-37 years, thus attacking individuals presumably in the prime of life.

Eleven showed rise of temperature (98·6°-102·2° F.).

Eight.—General anasarca.

Three.—Oedema of the legs alone.

Eight.—Vomiting.

Two.—Bilious vomiting.

Two.—Icterus.

Five.—Diarrhœa.

One.—Absence of any gastro intestinal symptoms.

Five.—Bilious yellow stool.

Nine.—A tender and enlarged spleen.

Six.—Systolic murmur at the base of the heart.

Five.—Headache (very severe in two).

Eight.—Ascites.

Four.—Pregnancy.

Twins at sixth month.

Two at seventh month.

One.—During labour.

Careful examination of the cases, one by one, leave little doubt that they are cases typical of Dr. Kennard's acute anæmia.

The results show that in pregnant women the onset of anæmia is indeed very acute, but in men and non-pregnant women the onset cannot be described as acute.

e.g., acuteness in pregnancy:—

East Indian, female, 7 months pregnant on admission.

Total number of red blood corpuscles ... 2,300,000 per cu. mm.

Total number of white blood corpuscles 5,500 "

Hoemoglobin ... 25 per cent.

Colour index ... 54

Differential count of leucocytes:—

Polymorphonuclears ... 65 per cent.

Lymphocytes ... 29 "

Large mononuclears ... 2 "

Eosinophiles ... 4 "

Nucleated reds ... 0 "

Nine days after admission:—

Total number of red blood corpuscles ... 1,300,000 per cu. mm.

Total number of white blood corpuscles 6,300 "

Hoemoglobin ... 21 per cent.

Colour index ... 87

Differential count:—

Polymorphonuclears ... 69 per cent.

Lymphocytes ... 27 "

Large mononuclears ... 1 "

Eosinophiles ... 1 "

Nucleated reds ... 2 "

Twenty-seven days after admission:—

Three days before death:—

Total number of red blood corpuscles ... 660,000 per cu. mm.

Total number of white blood corpuscles 5,800 "

Hoemoglobin ... 12 per cent.

Colour index ... 9

Differential count:—

Polymorphonuclears ... 63 per cent.

Lymphocytes ... 20 "

Large mononuclears ... 0 "

Eosinophiles ... 3 "

Nucleated reds ... 14 "

Example of non-acuteness of the anæmia in a man.

J., Male. East Indian.

On admission:—

Total number of red blood corpuscles ... 1,700,000 per cu. mm.

Total number of white blood corpuscles 4,800 "

Hoemoglobin ... 22 per cent.

Colour index ... 65

Differential count:—

Polymorphonuclears ... 64 per cent.

Lymphocytes ... 31 "

Large mononuclears ... 3 "

Eosinophiles ... 2 "

Nucleated reds ... 0 "

Thirty-two days after admission:—

Two days before death:—

Total number of red blood cells ...	...	1,900,000	per cu. mm.
Total number of white cells ...	...	5,200	"
Hoemoglobin ...	...	25	per cent.
Colour index ...	...	·66	

Differential count:—

Polymorphonuclears ...	...	62	per cent.
Lymphocytes ...	...	30	"
Large mononuclears ...	...	1	"
Eosinophiles ...	...	6	"
Nucleated reds ...	...	1	"

The greatest result of blood examination shows:—

Total reds, 2,300,000—660,000	per cu. mm.
Three showed counts below 1,000,000.	
Total whites, 8,400—4,100.	
Hoemoglobin, 30—12	per cent. Six below 20 per cent.
Colour index, ·9—·54.	

Differential count:—

Polymorphonuclears, 69—51	per cent.
Lymphocytes, 33—20	per cent.
Large mononuclears, 6—0	per cent.
Eosinophiles, 10—1	per cent.
Nucleated reds, 15—0	per cent.

The nucleated reds are mainly normoblasts not megaloblasts as Dr. Kennard believed.

The following measurements are taken from several blood films and the average calculated:—

Size of red blood corpuscles ...	...	·0082	mm.
Size of normoblast ...	...	·0090	"
Largest red blood corpuscle ...	...	·0095	"
Largest normoblast ...	...	·0098	"

Megaloblasts were seen in four cases.

The qualitative and quantitative changes indicate the presence of a severe secondary anæmia.

The autopsies revealed the cause of this secondary anæmia and are summarised below:—

Two cases showed.—Icterus.

Eight.—Anasarca.

Three.—Oedema of the legs.

All eleven.—Pale and anæmic organs.

All eleven.—Pale watery blood.

Seven.—Fatty heart. Thrush breast condition.

Nine.—Enlarged spleen (52 ozs.—12 ozs.).

Two.—Small spleen (7 ozs. and 4 ozs.).

All eleven.—Dusky chrome-coloured kidney.

Nine.—A yellowish-brown liver with occasional small hæmorrhagic spots (64 ozs.—41 ozs.).

Eight showed.—Few ankylostomes in the intestines.

Three showed.—Many ankylostomes in the intestines.

Four showed.—A condition of the uterus associated with pregnancy.

The other organs showed no very constant naked eye lesions.

The appearance of the organs, more especially the kidneys, conclusively proves that the cause of the anæmia is a condition of chronic ankylostomiasis, and, where very acute, has been aggravated by pregnancy.

Attention has been drawn to the connection between chronic ankylostomiasis and a peculiar dusky chrome colour of the kidney by Dr. Daniels 10 years ago in this Colony and by Dr. F. M. Sandwith in Egypt.

The condition of the blood as shown by the investigations detailed above are not contrary to the finding at the autopsy.

The blood appearances are intermediate between a mild attack of ankylostomiasis, as was described by Boycott and Haldane in Cornwall, and a severe almost fulminating attack of ankylostomiasis, such as was examined by Ashford in Porto Rico.

The condition of the organs has been brought about by the presence of the parasite over a long period of time and consists of a detrimental action on the parenchymatous tissue of the organs; leaving apparently the intestinal tissue comparatively untouched. In the kidney advanced fatty degeneration has occurred in the convoluted and descending tubules; cirrhosis does not occur. The liver, heart, and spleen are similarly affected.

After this change has been completed in the organ the presence or absence of the parasite (the original cause) produces but little effect on the course of the disease. The condition might well be characterised as ankylostomiasis cachexia.

2. *Acute Ankylostomiasis.*

Ankylostomiasis, as it occurs in this Colony, is usually recognised as an anæmia of varying intensity, from slight pallor of the mucous membrane with lassitude to a ghastly whiteness associated with complete incapacity; in either case the disease presents itself as a chronic or semi-chronic condition.

It is not unusual for diseases which usually are not acute to sometimes run an extremely rapid almost fulminating course; this is true of ankylostomiasis.

During the past six months four examples of such an extremely acute effect of infection with ankylostomes have passed through my hands, and for want of previous knowledge of the existence of such condition, the first three cases passed unrecognised.

I can find no reference in the literature of ankylostomiasis at my command, to such cases, except in "The Diseases of Egypt," by F. M. Sandwith. In Part I., on page 267, a case of rapid death from ankylostomiasis is described that might compare to the condition described below:—

Case 1.—G. Female. 60. E. Indian.

Was five days in hospital. Gave a history of "frothing at the lips" and "fit." No wasting. Well nourished. Remained in a semi-conscious condition. Deep jaundice. Costive. Temperature about 103·6. Spleen large.

Autopsy performed 6¼ hours after death. Well nourished. All tissues, specially fibrous ones, deeply jaundiced. Petechial spots over the serous membranes. No œdema. Brain and lungs natural. Spleen, 6 ozs., red, juicy, and firm. Kidneys, small cysts. No reduction of cortex or great fibrosis. No atheroma of the arteries. Liver, 42 ozs. Intestine full of ankylostomes (many hundreds) from the opening of the duct of Wirsung to the ileocaecal valve.

Punctate hæmorrhage ("Bites") very frequent. Blood and mucus in the cavity of intestines.

Case 2.—O. Male. 40. India.

In hospital, 1½ hours. No history.

Collapsed. Deep jaundice. Temperature, 103·2. No examination made.

Autopsy performed one hour after death.

A muscular man. Well nourished. Marked jaundice. Brain, slight œdema; no congestion. Old adhesions in R. pleura. Chronic bronchitis. Heart, fatty. Spleen, 16 ozs., chronic perisplenitis, juicy and firm. Liver, 36 ozs. Green bile in the liver and gall bladder; some early fibrosis. No stones.

Petechial spots over the serous membranes.

Stomach showed punctate hæmorrhage spots in the wall of the cardia.

The intestines had five irregularly placed ulcers, none near the ileocaecal valve; they were small with raised edges and depressed centre. Peyer's patches not prominent. A great many ankylostomes in the gut and here and there large patches of blood and mucus.

Cultures taken from the spleen on Agar showed two kinds of coliform bacillus, both producing gas and acid in MacConkey medium.

Case 3.—A. Male. 26. E. Indian.

In hospital 13 days. Jaundice. Liver not felt. Costive. Stools contain much blood-flecked greyish mucus. Temperature about 102·8° F. Convulsions preceded death. Autopsy 20 minutes after death. Muscular adult, well nourished. Deep jaundice. No anæmia. Brain healthy. Lung purplish patches outside. On section shows a very dull surface with many small petechial spots in the substance.

Heart not fatty. Aortic valve fenestrated. Spleen, 9 ozs., pale, red and fibrous. Kidney, pale yellow. Petechial spots on the serous membranes especially well marked on the omentum and mesentery. No hydroperitoneum.

Liver, 26 ozs., light yellow, lobules well marked. Bladder full of light green bile. Stomach, light grey fluid contents. Duodenum, upper part, clear. From just below the entrance of the duct of Wirsung to 30 inches above the ileocaecal valve is a large quantity of ankylostomes.

"Bites" are numerous and blood and mucus is present in quantity.

Case 4.—M. Male. 45. E. Indian.

Four days in hospital. Emaciated. Jaundice, purging, no blood in the stools.

Liver and spleen enlarged and tender. Temperature about 102·8° F.

Blood count showed 21 per cent. of eosinophile cells.

Autopsy, three hours after death:—

Emaciated. Deep jaundice. Petechial spots on serous membranes. Spleen, 40 ozs. Thick perisplenitis. Liver, 60 ozs. Intestine showed large number of ankylostomes. Many copulating. Some of the ankylostomes were jet black in the posterior end, due to the presence of a mycelial fungus which preys on the ankylostome here. Many "Bites." Blood and mucus in contents of the intestine. Reddening of the mucous membrane for four inches above the ileocaecal valve. The colon showed old healed and a little recent ulceration.

The above cases it is recognised are not conclusive and a greater number and closer investigation is required to definitely establish a condition of acute ankylostomiasis. This I hope to rectify as opportunity presents. Microscopic examination of the cases recorded will be performed but is not now complete.

I regard the condition as a toxæmia produced by the simultaneous infection by a large number of ankylostomes (many hundreds) each of which pours out a quantity of toxin from its cephalic glands which open into the mouth capsule. The toxin is carried to the liver which fails in its function as a toxin filter, either because of quantity or for other reasons, and leaves the whole body at the mercy of the parasite and its elaborated products.

3. *Granuloma Pudendi.*

Drs. Conyers and Daniels, Government Medical Officers of this Colony, described, in the British Guiana Medical Annual of 1896, a venereal condition which, though not limited to this Colony, yet is certainly not so common elsewhere as might be expected.

This disease is very prevalent amongst both men and women, very disfiguring, and extremely painful; moreover, it appears to be very contagious.

Examination of syphilitic lesions having brought to light the presence of a spirochæte, the granuloma was similarly examined, films were made and stained by Giemsa's solution for 24 hours—spirochætes were found.

Examination of 15 specimens showed spirochætes in nine and their absence in six.

As regards the spirochætes themselves, it is difficult to say whether they are all the same, whether they are different species, or whether even they are at all causally connected with the disease.

I intend applying some conventions separating the spirochætes into rough groups, microscopically by their "wave length," colorimetrically by their reaction to stains. I feel certain that such methods will result in several groups being resolved.

Grave doubts exist in my mind as to any causal connection between the spirochætes and the disease.

There are also present masses of small bodies which seem to represent some phase in the life history of a protozoal organism. Stained by either Leishman's or Giemsa's stain, a thin capsule is apparent surrounding a clear unstained space; in the middle of the space is a chromatin staining curved rod, thin in the middle and thicker, club-shaped, at each end. These bodies appear massed together in numbers varying from 2 to 25, and are often found within the leucocytic cells present.

4. *Spirochætes in General.*

Spirochætes are very commonly to be met with in this Colony.

Of sputa sent to be examined for the bacillus tuberculosis, 44 per cent. contain

spirochœtes (not spirilla); no doubt from the mouth, as I have found spirochœtes in lung substance but once.

Spirochœtes have occurred twice in urine and three times in stools; when occurring in the urine or stool they appear in immense quantities.

Following on the discovery by Dr. Castellani and Dr. Wellman of spirochœte in parangi and in yaws, Dr. Ozzard, Resident Surgeon at the Suddie Hospital, succeeded in demonstrating a spirochœte in the yaws of this Colony. I have since had several opportunities of confirming his observations.

There is a disease of dogs in this Colony which is venereal and marked by contagion. Mr. Raleigh, the Government Veterinary Surgeon, first pointed it out to me. It appears as a papillomatous condition in the dog and as an ulcerating granulomatous condition in the bitch. In this condition we are able to demonstrate spirochœtes in comparative abundance.

5. *Filariasis.*

The diseases grouped under this name and attributed directly or indirectly to the presence of filarial worms is very common indeed in this Colony, and by virtue of the fact that no treatment is known and that they result often in dire disfigurement, claim the earnest attention of all medical men.

My attention has been rapidly drawn to them and riveted on their protean forms by observing in the course of post-mortem examinations a peculiar condition of the abdomen which I have not seen before and to which I unhesitatingly attribute death.

Reference to Sir Patrick Manson's excellent writings on chyluria in Davidson's Hygiene and Diseases of Warm Climates showed that the condition I was observing was unquestionably filarial, resembling in many points the writer's description of Dr. Stephen Mackenzie's case.

This condition described below is called in Barbados "Fever and Ague" of the abdomen, and Dr. G. C. Low, writing in the British Guiana Medical Annual of 1902, prophesies with singular accuracy that such cases may turn out to be cases of lymphangitis affecting the structures of the abdomen.

The appearance is a very striking and peculiar one and seems closely connected with elephantoid fever of various kinds.

Dr. Daniels, in 1896, records the occurrence of enormous dilatation of the lymphatics of abdomen and thorax in several cases of elephantiasis.

Eight cases of what I will call abdominal filariasis (for want of a better name) have died in the Public Hospital, Georgetown, between July and December, 1906, of which five were in an acute stage causing death, and three in a chronic stage not concerned in the death of the patients.

Case 1.—T. male, black, of British Guiana, 50 years of age. Total attack lasted eight days. Complained of "pain in the left side and fever." Temperature oscillated between 105° F. and 100° F.

Slight jaundice. Vomiting and constipation. Inguinal glands of left leg discrete, swollen, and tender. Abdominal tenderness. Nothing else clinically discovered.

Post-mortem examination revealed chronic endocarditis of aortic valve. Spleen, large, 16 ozs., red, firm, and juicy. Acute peritonitis with yellow greenish pus. The retroperitoneal tissues enormously enlarged so as to resemble a tumour extending from the thorax through the abdomen to both groins. This mass was obviously a lymphatic structure and showed innumerable yellow points of pus in its structure. There was no other possible cause for the peritonitis. The further description of the mass will be added later.

Case 2.—W. female, black, of British Guiana, aged 65. Total attack lasted seven days. Complained of fever and pain in the left leg. Temperature ranged from 99° F. to 104° F. The patient had two rigors. Tongue clean. Vomiting. Slight jaundice. Shows induration and redness from near ankle to the groin of left leg, especially on the inner side; very tender. Typical elephantoid fever. No apparent injury to foot.

Post-mortem examination. Bronchial glands showed obsolescent tubercle. Advanced atheroma of aorta. Spleen, 11 ozs., enlarged, red, and firm. Intestines contained a few ascaris and its coils were united by a fine adhesive layer of plastic lymph. The retroperitoneal tissues were enlarged, extending from thorax to groins. In the left leg femoral inguinal glands were large and acutely inflamed.

Case 3.—B. female, black, of Barbados, aged 36. Total attack lasted five days. Complained of fever and pain in the left leg. States that the attacks occur periodically. Temperature from 100° F.—105° F. Tongue furred. Slight jaundice. Vomiting. Bowels free. Acute lymphangitis of left leg. Typical elephantoid fever. Post-mortem examination. Lungs, deep congestion. Heart, fatty. Spleen, 5 ozs., red, juicy, firm. In the posterior part of abdomen, guts are joined by plastic lymph while the anterior coils move freely one on another. Few ascaris in intestine. The retroperitoneal mass greatly enlarged. Left leg, acute lymphangitis, with enlarged and tender glands in the groins. Typical elephantoid fever. *Filaria bancroftii* found.

Case 4.—G. male, black, of British Guiana, 19 years of age. Total attack, 12 days. Complains of vomiting and abdominal pain and fever.

Temperature varies between 99° F. and 103° F.

Left inguinal glands very tender and swollen. Explored with a syringe on 3rd day—no pus found. Incised the glands on the fifth day, reddish thick material came away. Parotitis developed on both sides on the sixth day, which disappeared on the ninth.

Continued with vomiting, slight jaundice, and fever during the whole time till his death.

Post-mortem examination. Obsolescent tubercle in bronchial glands. Ductus arteriosus almost patent. Spleen, 7 ozs., dark, red, juicy. Kidneys of the large white type, 10 ozs. Intestines, nil. Retroperitoneal mass greatly enlarged. All the structures and walls of the abdomen were acutely congested, presenting what might be considered a preperitonitic condition. A small sinus in the groin where the glands had been incised. No lymphangitis of the extremities or scrotum.

Case 5. W., a female, black, of British Guiana, aged 40, complaining of "fever and ague." Whole attack lasted 4½ days. Temperature ranged from 104° F.—102° F. Fairly well nourished, tongue dry and furred, bowels constipated. Abdomen not especially tender. Fever resistant to quinine.

Post-mortem examination revealed slight atheroma of the aorta. Small spleen (4 ozs.) red and juicy. Intestines contained no worms. No peritonitis. The retroperitoneal mass was enormously enlarged.

The following three cases illustrate chronic enlargement of glands:—

Case 6.—M. male, black, of Tobago, aged 46. Total attack lasted 7 days. Complained of fever and ague. Temperature between 98° F. and 103° F. One rigor. Abdomen distended and tender. Vomiting. Constipation. Sudden collapse and death.

Post-mortem examination:—Edema of the lungs, slight atheroma of the aorta, purulent pericarditis. Spleen (7½ ozs.). Large white kidneys (10 ozs.). Acute peritonitis.

Retroperitoneal tissues thick and indurated, not soft and obviously inflamed as in the previous cases. Both legs advanced elephantiasis and glands in both groins hard and fibrous.

Case 7.—R. female, black, of Dominica, aged 18. Total attack, 3½ weeks. Temperature 100° F.—103° F. Septic endometritis, salpingo-oophoritis, peritonitis, and death.

Post-mortem examination confirmed the above clinical observations.

Lungs very anæmic. Spleen (7 ozs.) red and firm.

Abscess in the ovaries.

Retroperitoneal tissues showed chronic thickening.

Case 8.—M. male, East Indian, 45 years of age. Had been 36 years in British Guiana and had a six months' history of disease.

He was 37 days in the hospital suffering from cirrhosis of the liver.

No elephantiasis.

Post-mortem shows obsolescent tubercle at the apices of right and left lungs, miliary tubercles in both lungs. Aortic and pulmonary valves fenestrated. Spleen 48 ozs. Liver, 28 ozs. Cirrhosis.

Hydroperitoneum. Intestines contained ankylostomes.

Retroperitoneal tissues in a chronic condition.

No elephantiasis. Chiggers in feet.

The masses of retroperitoneal tissue in each of the above acute cases resemble each other very closely.

They are large, weighing from 25-40 ozs., and extend from the thorax at the level of about the bifurcation of the trachea down to the bifurcation of the aorta.

They are closely applied to the spine and surround the aorta, vena cava, and thoracic duct in an almost inextricable tangle of lymph glands and vessels.

At the bifurcation of the aorta, such a mass may end or proceed further down each iliac vessel to the groin where again it may end or, on the contrary, hold communication under Poupart's ligament with the inguinal and femoral glands.

Offshoots of this mass take place in the abdomen to surround each kidney (I have not yet examined a chyluric patient) the kidney readily shells away from the mass and there does not seem to be any anatomical connection between the two; also offshoots may pass down the sides of the pelvis over the obturator areas surrounding eventually the bladder, prostate, and rectum.

Leaving the gross anatomical description and turning to the constituent parts: the thoracic duct is plainly traceable in the thorax out of the head of the mass at the level of the tracheal bifurcation (being at that spot much dilated, up to one inch in diameter) and from that spot gradually tapering to its termination in one of the various veins at the root of the neck.

The thoracic duct is occupied by a smooth clot of lymph, yellowish-white in colour. The duct, once it enters the upper end of the mass, is extremely tortuous and extremely difficult to follow in all its twistings; it here and there receives branches, some of the same size as itself, containing the same clot and varicose and tortuous in the same fashion.

Finally, the duct is lost altogether.

About two inches below the upper end of the mass the contents of the duct and its branches change and, instead of a smooth yellowish-white clot, there appears a disintegrated brick-dust (faint red) fluid; as the main bulk of the mass is reached, the contents of the lymph vessels (and lymph glands) become a thick brick red semi-fluid material, which oozes slowly from the open structures. In some cases the contents even become ordinary thick whitish pus.

All graduations from white clot to brick-red semi-fluid material through many miliary abscesses to frank undisguised pus may be found in a single mass.

In only one case was the *Filaria bancroftii* found (in Case 3). The embryos were discovered in the blood and the adult in the retroperitoneal mass quite dead and lying between the two kidneys. In no case was the adult filaria found in the thoracic part of the mass which I have carefully examined for that purpose; it is an impossibility to examine the rest of the mass single-handed.

Smears of the matter in the lymphatics and glands show an enormous abundance of streptococci and cultures on agar bear out the extraordinary profusion of these organisms.

The chronic condition of the retroperitoneal mass is one in which the mass is very much smaller and rarely extends above the crura of the diaphragm and below the bifurcation of the aorta. It is hard, thickened, and on section appears to be composed mainly of fibrous tissue.

Lymph glands embedded in the fibrous mass are easily recognisable and dilated lymphatics and blood vessels are apparent. When peritonitis supervenes the patent, dilated thick-walled lymphatics contain pus. Otherwise these chronic masses show no sign of any acute change.*

The microscopic and bacteriological examination of the above material is now being carried out.

Filarial disease is a subject in which of recent years theory has played much part and actual observation of facts (of the diseases themselves, not of prophylaxis, &c.), has been much neglected. I record these cases here with a detailed account of their autopsies because they fill a great vacancy in medical literature and throw considerable light on the cause and pathogenesis of a most interesting disease.

They, furthermore, furnish a basis for experimental and therapeutic observations which are now proceeding at a rapid rate.

I do not need to emphasise the hope that the observation of a streptococcus, which may turn out to have some causal action in these diseases, raises in the minds of tropical practitioners.

* No streptococci were found in scrapings from these masses (the pus in the peritonitic cases contained bacilli.)

A streptococcal disease is one which can be combated in several specific ways, a filarial disease is one that reads despair.

K. S. WISE.

No. 2 in Appendix VII.

BRITISH GUIANA.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received December 31, 1907.)

MY LORD, Government House, Georgetown, Demerara, December 12, 1907.

IN continuation of my despatch of the 19th March last, I have the honour to transmit a report by Dr. K. S. Wise, Government Bacteriologist, on the work done in connection with Tropical Diseases Research, in the Bacteriological Laboratory of this Colony, during the nine months ended the 30th September, 1907.

I have, &c.,

F. M. HODGSON.

Enclosure in No. 2 in Appendix VII.

A REPORT on work done in connection with Tropical Diseases Research in the Bacteriological Laboratory of British Guiana during the nine months ending September 30, 1907.

I. ACUTE FILARIASIS.

In my report of the six months ending December 31st, 1906, a series of eight cases is described in which a disease process called Filariasis affects the retro-peritoneal tissues of the abdomen.

To label a disease Filariasis is easy, but to define the limits within which that name shall be used is difficult.

The name Filariasis obviously belongs to diseases in which a filarial worm is the active or predominant feature of its causation. This, though simple as a definition, is often extremely difficult of determination. These worms are elusive, and prolonged examination suffices often to show not the worms themselves but only the slightest indications of their presence.

However, I have in general limited the name to diseases where the lymphatic tissues are affected in a peculiar fashion, but it has been necessary to extend the name to other conditions in which the worm reveals itself at the fountain-head of a disease which may not at first-sight show peculiar lymphatic lesions.

The peculiar lymphatic lesions characterising Acute Filariasis are described in my last report, and it is superfluous to repeat them here.

A distinct abdominal type of Filariasis was delimited by the previous series of cases; this type was sometimes, but by no means always, associated with superficial lymphangitis of the leg or legs.

It is necessary to point out that the converse condition, viz., that in which the leg is attacked with lymphangitis while the abdomen remains unaffected, occurs frequently, in fact is the usual form of the disease. For death to occur when the disease is limited to peripheral lesions is unusual, but now and again such occurs.

In illustration:—

Case 9 (in continuation of last report).—M.B. female, black race of British Guiana, age 23. Total attack three days, in hospital one and a half days. Complained of fever and vomiting. Temperature 105.0° Fahrenheit, dropped to 98.0° Fahrenheit and then rose to 103.4° Fahrenheit. Liver and Spleen slightly enlarged and tender; not much anæmia. Tongue furred and dry. Elephantiasis of left foot with two small ulcers, no elephantiasis of right leg. Acute lymphangitis of right leg.

Post mortem.—Acute lymphangitis right leg; groin glands on right side red and acutely inflamed, on left side white and chronic. No enlargement of abdominal glands. Spleen firm, dark red and juicy. Liver 68 ounces, firm, congested and dark brown. Intestines contained a few ankylostomes.

I wish now to draw attention to a second distinct and separate group of cases of Filariasis in which the same essential lesions are found, but which occur in a different part of the body, *i.e.*, the testis and spermatic cord. This group is quite

separate and in no way connected with Scrotal Filariasis. The skin of the scrotum is unaffected with either acute or chronic changes.

Hydroceles are a great deal more commonly met with in the tropics than in temperate climes, but I do not propose for a moment that all hydroceles in this part of the world are filarial, far from it. But that some are is unquestionable, in fact many acute purulent hydroceles fulfil both conditions of a filarial disease, viz., a peculiar lesion of the lymphatic tissues and the presence of the worm at the origin of the disease.

Cases illustrating this testicular type of acute Filariasis:—

Case 10.—C.P. male, black race of British Guiana, age 21. Total attack six days. Complained of fever, bilious vomiting and constipation. Temperature oscillated irregularly between 103.4° Fahrenheit and 100.0° Fahrenheit. Jaundice; abdomen tender in right iliac region; vomiting fairly frequent; vomit contained round worms. Pain in scrotum not acute; skin desquamating; right spermatic cord enlarged. Widal negative. Blood showed a polymorphonuclear leucocytosis.

Post mortem.—Well developed young fellow; excellent muscular condition. Deeply jaundiced. Rigidity not yet set in. Glands enlarged in right groin. Right acute fibrinous pleurisy. Spleen 13 ounces; dark red, firm, juicy and tense. All organs deeply jaundiced. Intestines, few anchylostomes, many whip-worms, loose, "pea-soup" contents. Liver 72 ounces; no obstruction to biliary flow, bile dark green. Stomach mucous membrane injected. Right spermatic cord greatly enlarged, 2 inches in diameter, extending in the same condition from the internal abdominal ring to the epididymis. The whole is filled with purulent matter which teems with streptococci. Acute purulent hydrocele is present in the right tunica vaginalis; the testis seemed free from suppuration. Small ulcer on outer side of right ankle.

The right spermatic cord seemed to have been affected before, since microscopic examination revealed a fibro-blastic interstitial thickening. The major portion of the cord was occupied by a dense semipurulent mass rich in fibrinous material resembling in some places lobar pneumonia. The testis also shows old interstitial thickening, indicating a previous attack, as well as recent suppurative inflammation. At the junction of testis and epididymis are encysted *Filaria bancroftii* containing eggs and embryos; the cyst is fibrous and shows round in giant cells. The filariae are surrounded by pus. Filarial embryos were discovered in the lung.

Case 11.—S. male, East Indian, 55 years of age. States that the whole attack lasted two days (this must be doubtful); was in hospital four hours and then died. He complained of fever, vomiting and slight jaundice. He was difficult to examine. Temperature 104.6° Fahrenheit. Heart action hurried; some consolidation suspected at the base of left lung.

Post mortem.—In fair condition, not emaciated. Right scrotum swollen. Spleen 24 ounces, dark red, juicy and firm. Intestines natural, no worms. Liver 56 ounces, congested, no biliary obstruction. Right acute purulent hydrocele. Spermatic cord in same condition as in Case 10, but the enlargement does not cease at the internal abdominal ring, but proceeds for one inch along the right iliac vessels (not towards the bladder). Examination showed streptococci in profusion. Four *Filaria bancroftii* were found coiled up in the tissue at the junction of the epididymis and testis; presumably the starting point of the infection. Filarial embryos were found in quantity in the lungs.

Case 12.—B. male, East Indian, 38 years of age. States that the whole attack lasted nine days; he was two days in hospital, complaining of fever. He was weak and dazed, temperature between 104.6° Fahrenheit and 103.4° Fahrenheit. Frequent motions. Passed blood in the stools (external piles present). Slight distension of abdomen, spleen enlarged. A petechial rash which disappears on pressure, is present over the thorax and abdomen. Widal reaction negative. Right testis and epididymis swollen and painful.

Post mortem examination five hours after death.—No wasting, spleen 76 ounces, red and congested. Intestines natural, a few trichocephalus dispar. Right tunica vaginalis full of pus. *Filaria bancroftii* were found in the connective tissue at the junction of testis and epididymis. Spermatic cord unaffected. Filarial embryos were found in the kidney. Microscopic examination of the tissue in which the adult filariae lay showed that eggs and embryos lay loose in the connective tissue outside the worm. The upper part of epididymis and spermatic cord revealed no ova or embryos.

Many other cases might be quoted illustrating the same type of the acute disease, but the above three are very typical and serve the purpose of illustration.

A third type which is common in this Colony is the breast and upper-arm type, involving the axillary glands, sometimes the clavicular and tracheal. The thoracic duct is also sometimes invaded.

As illustration :—

Case 13.—M.L. female, black race of British Guiana, 20 years old. Total attack lasted 32 days, in hospital for 28 days. Complained of fever. Patient is a healthy, robust woman. No signs of elephantiasis or old filarial trouble. Temperature oscillated irregularly between 104.0° Fahrenheit and 100.0° Fahrenheit, but on five occasions reached 105.0° Fahrenheit and over. Pulse rate on the whole slow—only three times exceeding 120. Constipated. On admission there was a suspicion of consolidation at the base of right lung. This soon cleared up. Slight swellings in the groins, which are painful, more particularly on the right side. No tenderness of the abdomen. Copious bilious vomiting and well-marked jaundice.

Two days after admission (six days after onset of illness) the whole of the left arm is hot and painful and swollen. There is a distinct line of induration on the inner side of elbow. Still no abdominal tenderness.

Four days after admission the right arm became hot, painful and swollen, involving also the right breast. The left breast is unaffected. The slight masses in the groin remain painful, though there is no affection of the legs. The axillary glands cannot be felt but deep palpation is tender.

Eleven days after admission, the arm and right breast have subsided. The temperature still remains high and the jaundice persists. The stools are normally coloured. Eighteen days after admission two small abscesses were opened on the inner aspect of the right arm over the line of the lymphatics.

Twenty days after admission a similar abscess was opened in the left arm.

Twenty-five days after admission the left breast had a limited attack of acute lymphangitis.

Twenty-eight days after admission the patient died.

Post mortem examination revealed two small sinuses in the right arm, one small sinus in the left arm. Double acute fibrinous pleurisy due to contiguity of the thoracic duct. The lymphatic trunks of right and left arms are greatly thickened, especially in the axilla. Here and there they contain encysted abscesses. The thoracic duct from the root of the neck to the diaphragm was full of pus. Ligatured at the lower end it was removed just like a test tube. Axillary glands slightly enlarged. In the neck up each side of the trachea, around the pancreas and stomach, and over the anterior surface of the vertebral column there is an increase in number and tortuosity of the lymphatics. These are not, however, filled with pus, but with a slightly blood-tinged opalescent fluid.

The other organs showed no unusual character.

Case 14.—K.T. female, black race of Barbados, 37 years old; admitted to hospital complaining of fever for the last four days, associated with pains over the whole body. No evidence of old filarial disease, no history of any acute attacks. The left arm and breast are acutely inflamed. Pectoral glands enlarged and painful (not axillary). Temperature 104.0° Fahrenheit-100.0° Fahrenheit.

On the third day after admission the left arm was still painful and indefinite fluctuation appeared on axillary border of left breast.

On the seventh day jaundice appeared, abdominal tenderness and small swellings in the groin. Left breast still tender on deep pressure. Axillary glands now enlarged and tender. No vomiting but nausea is present. On the fifteenth day temperature is normal, skin desquamating, abscess at the axillary border of the left breast has become subacute. On the twenty-eighth day two small subacute abscesses appeared in each arm just above the elbow. They were not opened. The patient left hospital in this condition. On the seventy-seventh day after the original admission, the patient reappeared at the hospital complaining of dyspnoea and anasarca. Considerable præcordial pain, anæmic, albuminous urine, crepitations over both lungs. Temperature normal. While the subacute abscess in the breast is still palpable as a nodular mass, those in the arms have disappeared.

On the hundred and eleventh day, while still in hospital, an acute lymphangitic attack of the left breast developed, and the temperature rose to 104.0 Fahrenheit.

On the hundred and eighteenth day the attack subsided and death ensued on the hundred and twenty-third day.

Post mortem examination showed fatty heart and general œdema of the tissues. Old tubercular foci in right lung. A small fibrous congested spleen (2½ ounces). The left breast and the lymph vessels of both axillae in the proliferative stage of inflammation. Chronic enlargement and thickening of the glands in right and left groins. The mass at the axillary border of the left mamma consisted of chronic thickening in and about pectoral lymphatic glands. The ovary, broad ligament, and fallopian tube thickened, enlarged and fibrous.

The various tissues involved in the course of the disease were all in the proliferative stage of repair after inflammation. No traces of filarial worms were found.

It should be remembered that in the second and third groups, as in the first, the superficial peripheral parts may be attacked while the central proximal organs remain unaffected.

Though the groups indicated above are the most usual types, it must be recognised that combination of types and complete irregularity are by no means uncommon.

The following case illustrates combination of type:—

Case 15.—H.C. female, black race of British Guiana, aged 40. Total attack eight days; two days in hospital. Complains of fever and pain in the chest and legs. Temperature 103.2° Fahrenheit-99.8° Fahrenheit. Old elephantiasis of both legs.

Acute lymphangitis began first in the right leg at the ankle and spread up to the groin. Next day the left leg was similarly attacked. Glands in both groins enlarged and tender. Three days after the left breast is in a state of acute superficial inflammation. Five days after the right leg begins to abate but is still exquisitely tender over the line of lymphatics on the inner side of the leg. Some abdominal tenderness and vomiting.

Post mortem.—A very fat woman (2½-3 inches of fat in the abdominal parietes).

Double fibrinous pleurisy. Liver 76 ounces, full of bile, yellowish brown. Left leg acutely inflamed, groin glands enlarged and purulent. Right leg subacute, glands subsiding. The retroperitoneal mass is enlarged and extends from the iliac region up through the thorax to the left axilla. Left breast inflamed. The mass also extends to both obturator foramina and over both kidneys. (No chyluria.)

The following case illustrates complete irregularity:—

Case 16.—A.D. female, black race of British Guiana, age 14. Total attack seven days; in hospital one day. Complained of pain in the abdomen and arm, not very severe, for the last six days. Temperature 102.6° Fahrenheit. Abdomen distended and tympanitic. No history of diarrhoea, no vomiting. Tongue dirty and furred. Acute lymphangitis of right arm.

Post mortem.—The body of a well-nourished and well-developed young girl. Spleen 7 ounces, firm, dark red and juicy. Early acute peritonitis. In the pelvic tissues of right kidney lie two *Filaria bancroftii* in a bag of pus which communicates with the cavity of the renal pelvis. Ureteritis and cystitis are present. Where the right ureter passes over the brim of the pelvis the tissue round it is thickened and inflamed. The right broad ligament, fallopian tubes, and ovary are affected. It is from this spot that the peritonitis seems to start. Uterus healthy. Left basal pleurisy. Inner side of right arm shows deep and superficial lymphangitis. No obvious pus. Glands in right axilla enlarged and inflamed.

From kidney, ovary, peritoneum, spleen, arm and groin gland streptococci were obtained in culture.

This is an extraordinary collection of lesions, and shows that much has yet to be learnt concerning this disease.

II. CHYLURIA.

This is a disease which all who read tropical pathology recognise as peculiar and unique; to those who have the opportunity of studying the disease and examining the various pathological products of patients who suffer from Chyluria, there appear points which make an enquiry of absorbing interest.

The urine is of usual quantity and average specific gravity rarely below 1010 and rarely above 1030.

The re-action when fresh is invariably alkaline, never acid. It is heavily loaded with proteid; I have never found sugar present. The quantity of urea

seems undisturbed. The appearance of the urine immediately after passing is a light brick red, opaque and opalescent fluid, with here and there reddish, bloody flecks. Almost always, except in old and frequently repeated cases, a few small, blood-tinged, fibrinous clots are present which settle to the bottom of the glass. These small clots are formed in the bladder and passed per urethram. If allowed to settle for four to five hours the urine of older cases develops the usually described three layers. At the bottom is a thin layer of red deposit, perhaps one-eighth of the full glass, in the middle four-eighths is a thin, milky white, slightly maroon-coloured layer in which are large loose clots of fibrinous material, hardly blood-stained at all, the upper three-eighths is a white opalescent layer.

Microscopical examination shows that the lower-most layer is composed of red blood corpuscles and numerous small clots deeply blood-stained. No tube casts, epithelial cells, &c. The middle and upper layers show nothing at all and appear as homogeneous fluids having no deposit or suspended matters of any kind whatever.

When the Chyluria is of recent development, the urine does not settle into three layers but only into two, a deposit of one-eighth of the glass and a supernatant fluid of seven-eighths. The deposit is almost wholly red blood cells and clot, while the fluid is a deep maroon colour, the opaque whiteness being obscured by the blood tinge. The bulky white clots appear in these cases as in the older ones.

It is stated that "within a very short time the whole of the urine becomes coagulated. Gradually the coagulum contracts until at the end of some hours a small, more or less globular clot, usually bright red or pinkish in colour, is floating about in a milky fluid."

This I have never seen. The Chyluric urines in this country never clot as a whole and then shrink, on the contrary, the clotting starts 5 to 10 minutes after withdrawal and proceeds from two or three separate foci and never involves the whole volume of the urine. The clots are from the beginning loose and floating in the fluid, and but little shrinking seems to take place. In the reddish layers of the urine, the distinctive bands of hæmoglobin are always readily determinable by a Browning spectroscope.

In none of the five cases examined have filariae in any stage of their existence been discovered. I am informed by a private practitioner in the town that in one chyluric urine which he examined, living embryos were found in large quantities, so they are by no means always absent. If the clot be embedded, sectioned and stained strands of fibrin form the matrix with a considerable amount of black pigment (melanin occurs largely in filarial disease), which is in general collected in leucocytes. Very little blood is present. The mononuclear type of leucocytes form the great preponderance of cellular elements in the clot. No filarial embryos or eggs can be seen in the clot.

In the customary descriptions of the urine of this disease, the presence of fat in readily recognisable quantity is unanimously agreed upon by all authors. I therefore find it strange and unaccountable that though the clinical appearance of the patient and the microscopic appearance of the urine correspond so closely to the usual accounts yet the chyluric urines here are free from fat.

Fat extractions have been made in different cases in the same case at different times of the day and on different days.

The procedure adopted was to take 50 or 100 ccms. of urine and gently agitate with ether for 10 minutes, sometimes with alkali, with acid or without either. The ether was then evaporated carefully at 20° C. under cover. The weight of the evaporating dish never varied more than in the fourth place of decimals, which was obviously due to error in manipulation.

The milky opacity is due to a large proteid content because when a sufficiency of proteid precipitant is used the filtrate appears clear as urine with no opacity or opalescence. This could not be the case were fat the cause.

Four typical precipitants were used, *i.e.*, heat, alcohol, trichloroacetic acid and tannic acid. Each of these caused a heavy precipitate of albuminous material and total abolition of opacity or opalescence.

Prolonged contact with ether causes the reddish colour to be replaced by a dull putty grey colour. Acetic acid 2 per cent. has the same effect; the further addition of pot. ferrocyanide produces a deep precipitate of proteid.

The quantity of proteid material deposited by treatment with trichloroacetic acid is (average of 10 estimations) .93 gramme per 25 cc. or 3.72 gramme per 100 cc. By treatment with tannic acid the result is .85 gramme per 25 cc. or 3.40 gramme per 100 cc.

The qualitative determination of the proteids present is difficult, and I offer here a few preliminary observations.

The old original process of salting out was adopted and the usual salts—sodium chloride and ammonium sulphate used. This process was adopted in preference to others such as fractional heating in that salting out does not denaturalise the precipitate and permits resolution and further examination. The old notation for expressing saturation limits of precipitation is abandoned as too artificial. The solid salt was added and the precipitation limit stated in grammes of salt per volume of fluid and calculated to a percentage of complete saturation for the salt used.

It is needless to record the details of all experiments done; the following is a fair example of the average results obtained.

Twenty cubic centimetres of recently (within five minutes) passed urine were taken and sodium chloride in crystals added, $\frac{1}{2}$ gramme at a time, the fluid carefully shaken and examined for deposit. After the addition of 3.5 grammes of salt a delicate, light, flocculent precipitate floating on the surface appeared: 3.5 grammes to 20 cc. is 17.5 to 100 cc.; the saturation quantity of NaCl at the laboratory temperature is 35.0, therefore the percentage saturation for this precipitate is exactly 50.

This flocculent mass dissolves in dilute saline solution and coagulated at 57.0° C. There can be little doubt that this is fibrinogen.

To continue, at the addition of a total of 4.5 grammes of NaCl, another white precipitate shows, this time granular and heavy, falling to the bottom.

This precipitate also dissolves, though not so readily, in dilute saline solution. This solution has two coagulation points, viz., at 64.0° C. and 73°-77° C. The proteid coagulating at 64° C. is probably fibrinoglobulin resulting from clotting in the bladder, that at 73° to 77° C. is probably globulin incompletely precipitated.

Further addition of NaCl up to 7 grammes (*i.e.*, saturation) continues producing precipitates of globulin. Saturation with sodium chloride does not eliminate all globulin.

Further additions to the filtrate of ammonium sulphate to saturation (*i.e.*, 15.4 grammes) produce a heavy precipitate. This on solution and heating, precipitates at 68° C. and 73°-77° C.

The lower precipitant is an albumin, the higher is the remainder of the globulin.

The double saturation with sodium chloride and ammonium sulphate has not, however, removed all proteids. The filtrate gives a well-marked biuret re-action, and is precipitated by a solution of iodine in potassium iodide added to the saturated salt filtrate. This is without question peptone.

Though the isolation of albumoses has been impossible the presence of peptone is strong evidence of both primary and secondary proteids of this type.

If the urine be examined in exactly the same way but after extra-corporeal clotting, the fibrinogen flocculent precipitate is absent and unobtainable.

The origin of this large proteid content can only at present be a matter of conjecture; I have little doubt but that it is closely connected with the presence of the enlarged retroperitoneal masses previously described. It certainly is not due to the faint tinging of blood which colours the urine.

As an addendum to this description of chyluria, I add an account of some fluid obtained from chylous swelling on the upper part of the thigh which was received early in 1906. It agrees with the chyluric urines in being free from fat.

The fluid was removed by a large syringe and allowed to flow through the needle.

It was of a light straw colour showing a curious opacity and opalescence, also seen in the urine of chyluria. It was remarkably viscous and does not separate into layers at all. After two days absolute quiet, it shows a faint indication of two layers.

Microscopically it is full of leucocytes, obviously undergoing degeneration, being extremely vacuolated; masses of detritus abound.

No fat globules seen. Ether does not clear up the fluid. Only a few red blood corpuscles present.

Prolonged centrifuging revealed no traces of filariae.

Chloroform neither destroyed the opalescence nor removed the straw-coloured pigment. Alcohol threw down an immense precipitate of proteid material, the fluid immediately becoming solid. Heating produces the same result. In both cases the resultant filtrate was clear. No sugar detected.

No clotting was observed unless the viscosity is regarded as a loose general clotting. The general impression obtained of the fluid was that of a mass of obstructed lymph undergoing degeneration and destruction perhaps eventually to become a fibrinous nodule.

Public Hospital, Georgetown,
November 19, 1907.

K. S. WISE,
Government Bacteriologist,
and Pathologist.

No. 3 in Appendix VII.

CEYLON.

THE GOVERNOR to THE SECRETARY OF STATE

(Received May 13, 1907.)

The Queen's Cottage, Nuwara Eliya, Ceylon,

MY LORD,

April 24, 1907.

I HAVE the honour to forward a report on "Yaws," with an album of photographs and drawings,* and a report on opsonic treatment by Dr. Castellani, Director of the Bacteriological Institute, Ceylon.

I have, &c.,
HENRY A. BLAKE,
Governor, &c.

Enclosure 1 in No. 3 in Appendix VII.

FRAMBÆSIA TROPICA (YAWS).

By ALDO CASTELLANI, M.D., Director of the Clinic for Tropical Diseases, Colombo (Ceylon).

The disease was first called *Frambæsia* by Sauvages in 1759, because of the raspberry-like appearance of the eruptive elements. Charlouis, in 1882, suggested the name *Polipapilloma tropicum*. The affection is called Pian by the natives of the French Colonies (Antilles); Yaws by the West African negroes; Paranghi by the natives of Ceylon.

Other synonyms are Momba (Angola), Dubi (Gold Coast), Tetia (Congo Coast), Framosi (Calabar), Aboukone (Gaboon), Gattoo (West Coast of Africa), Kuena (Burmah), Puru (Borneo, Federated Malay States), Patek (Dutch Indies), Tonga (New Caladonia, and Loyalty Islands), Coco (Fiji), Tona (Tonga Island), Lupani Tomo (Samoa). In Venezuela and other South American countries the name Bubas is much used.

GEOGRAPHICAL DISTRIBUTION.

Yaws is essentially a tropical disease, as few, if any, genuine cases have been reported from temperate zones. There are authors, however, who believe that yaws was in the past endemic also in temperate zones. For instance, the so-called "button scurvy" disease which was common in Ireland about a century ago, is considered by some to have been a form of frambæsia.

The peculiar disease known as sibbens or sivvens, an outbreak of which occurred in Cromwell's armies and in Scotland in the seventeenth century, has been also believed to be yaws, though it is much more probable that it was syphilis.

At the present time cases of a skin disease resembling yaws have been reported by several writers in Greece.

Africa.—The disease is very rare in the northern regions of the continent; it is said to be occasionally met with in Algeria; it is apparently non-existent in Egypt, though, according to some writers, fairly common in some districts of the Soudan. Yaws is very common on the West Coast, Congo Free State, on the Gaboon River; it is also found in Mozambique, Angola, Madagascar, and the Comoro Islands. In Uganda and the region of the great lakes it is occasionally met with. Recently Griffith has observed yaws among the Kaffirs in South Africa near Kimberley.

* Not reproduced.

Asia.—The disease is unknown in Japan, and in the central and western regions of the continent. It is also unknown in most parts of China. The affection is frequently met with in the Malay Peninsula, Upper Burmah, Siam, and is extremely common in Ceylon, where it is called parangi. The number of cases reported in Ceylon during the last six years was as follows: 3,646 in 1900; 3,117 in 1901; 3,434 in 1902; 3,254 in 1903; 3,501 in 1904; 3,535 in 1905. In India cases of yaws are very rare, though small outbreaks of the disease have been described by various observers.

Australasia.—The disease is not present in Australia, Tasmania, and New Zealand, while it is of frequent occurrence in many of the Pacific Ocean Islands.

It is extremely common in Fiji, British Guinea, Loyalty Islands, Samoa, New Hebrides, New Caledonia.

America.—In the West Indies and French Antilles, yaws is very common. In Cuba some cases occur. It is known in British Guiana, Venezuela, and Brazil. Cases have been occasionally reported from the Southern United States, but never from the Northern States or Canada.

HISTORY.

In the works of Avicenna and Ali Abbas of the tenth century, there is mentioned a disease called "sufat" with symptoms somewhat similar to those of yaws. It is generally admitted, however, that the disease referred to by the two Arabian doctors was probably syphilis.

The first description of yaws appeared in the year 1525, it was written by Ovicedo, a Spanish doctor, who had studied the disease in St. Domingo. Yaws was later on described by Bontius, Piso, and Teter Labat. In our time the clinical symptoms, the geographical distribution and pathology of the disease have been investigated by a very large number of observers among whom are Charlouis, Corre, Powell, Nicholls, Manson, Mense, Plehn, Unna, &c., &c.

SYMPTOMS.

After an incubation period varying in length, but generally not exceeding three to four weeks, characterized often by signs of malaise, rheumatoid pains, headache, irregular rises of temperature, a primary sore appears at the seat of inoculation, which is generally extra-genital; in women it is very often found on one of the mammæ; in men and children on the trunk and arms.

The primary growth at the seat of inoculation is a papule which becomes moist and gradually develops into a rather large fungoid growth, covered with a crust, not very dissimilar from the elements of the general eruption which appear later on, but frequently larger. This large single projecting tubercle is called "mother yaws" or "maman pian" in French patois. By the Samaons it is called "ta'rr" or *leader* (Turner). This primary growth may remain single for several weeks, and even months. It sometimes heals before the general eruption begins.

Before the typical general eruption of yaws begins, some furfuraceous, whitish, pruriginous patches may appear on the trunk and limbs. These may coalesce, and cover large portions of the body. Some of them may disappear leaving the skin without lustre and rough. Others may remain during the whole course of the disease. It is on these furfuraceous patches that, according to many writers, the elements of the general eruption appear; in my experience, however, these may develop also on parts of the skin that are absolutely normal.

The general typical eruption of yaws makes its appearance in the form of papules. Frequently the first crop of these elements appear round the primary lesion. The papules are at first very small, often flattened, and with the epidermis intact; some of them disappear; others increase in size, becoming moist, and are soon covered with a crust, yellowish or brownish in colour formed of dessicated secretion; if the crust is removed a raw surface will be observed throwing up coarse red or yellowish fungoid granulations secreting a thin, slightly-purulent secretion, which soon dries into a crust again. These growths are of various size, and practically may be found on any part of the body; they are extremely common on the upper and lower limbs and on the face; on the scalp they are very rare. They may remain of the same appearance and size for months; often after a few weeks the secretion diminishes, and a process of hyperkeratosis sets in; they become of much

harder consistency, and some of them, especially those on the feet, may be covered with numerous hard, verrucose-like, small protuberances. Generally within three to six months in children, and six to twelve months in adults, the yaws dry up, shrink, and disappear; leaving dark, hyper-pigmented spots in their site. In some cases the eruption is very persistent, and appears in successive crops; in other cases large irregular ulcers may develop, showing often in their centre reddish papillomatous masses which, in my experience, do not usually heal spontaneously.

Constitutional symptoms of severe nature are generally absent during the whole course of the eruption in ordinary cases; the physical examination of the internal organs does not reveal anything abnormal; a few superficial lymphatic glands may be enlarged. The analysis of urine does not reveal anything abnormal. The stools may contain ova of various worms, but this also is of frequent occurrence in normal natives.

The Blood.

In all my cases in which the blood was examined, a certain degree of anæmia, never very severe, was present. The number of red blood corpuscles varied from 3,000,000 to 4,100,000; the hæmoglobin index (Fleischl) from 50 to 75. The red blood corpuscles did not show anything abnormal in their shape. On several occasions I noticed a comparatively large number of polychromatic erythrocytes staining blue instead of pink with Leishman's method. Many of these basophile red cells are microerythrocytes.

The leucocytes varied from 7,000 to 11,000 per cmm.

In the majority of cases an increase was noticeable in the number of the large mononuclears, even when there was no sign and no history of malaria. In almost all the cases the eosinophiles were increased, this being possibly due—in part at least—to the presence of intestinal worms as revealed by the microscopical examination of the stools, which showed frequently ova of *Ascaris lumbricoides*, *Tricocephalus dispar*, and in a few instances, of *Ankylostoma duodenalis*.

I attach a table giving the results of the examination of the blood in eight typical cases.

TABLE SHOWING RESULTS OF BLOOD EXAMINATION.

Cases.	Hæmo- globin.	Red Blood Cells per cmm.	Leuco- cytes per cmm.	Differential count of Leucocytes (per cent. without fractions).				
				Polymorpho- nuclears.	Large Mono- nuclears.	Small Mono- nuclears.	Tran- sition Forms.	Eosino- philes,
1. Woman ...	65	3,900,000	11,000	46	34	9	3	7
2. Boy ...	70	4,000,000	9,000	41	26	25	6	2
3. Girl ...	60	3,800,000	7,000	64	15	11	2	8
4. Girl ...	65	4,100,000	10,000	52	20	15	3	10
5. Girl ...	50	3,500,000	6,800	56	11	13	5	15
6. Boy ...	60	3,000,000	5,200	60	10	15	5	10
7. Man ...	50	3,200,000	6,000	59	15	10	4	12
8. Man ...	52	3,100,000	7,400	55	14	16	6	9

Cerebro-spinal Fluid.

In three cases of typical yaws I have performed lumbar puncture, collecting in each case about 20 cc. of fluid. The liquid was in all cases perfectly clear, like distilled water. The pressure was not increased. The physical and chemical characters were alike in all cases, and apparently did not show much difference from what is found in normal conditions.

The density varied between 1.003 and 1.005. A certain amount of globulin was present, and a substance (dextrose ?) reducing Fehling's liquid. This reducing

substance was, in two cases, distinctly in excess of what is observed in the normal fluid. No cholin was found. The reaction of the fluid was alkaline. In two cases the centrifuged liquid examined microscopically, did not contain any cellular elements; in the third a few, extremely rare, mononuclear cells were found. The liquid was sterile; no spirochætes could be detected.

SEQUELÆ.

Some of the old authors mention gumatous-like thickenings and various ulcerations comparable to tertiary syphilitic lesions. This is generally denied by the majority of recent observers. I have, however, myself come across some pathological lesions which may with much more probability be ascribed to a prægressed attack of yaws rather than to syphilis. I will limit myself to mention two such cases:—

Case I. Young Singhalese girl of about 14 years of age. No history of syphilis either congenital or contracted; she is a strong looking girl, her teeth, eyes, and ears normal; her genital organs are intact; five years ago suffered, together with all the other members of her family, from yaws, and was treated in a Government hospital from which she was discharged cured a few months later. She remained in good health till four months ago, when she noticed a slight indolent swelling on her right leg which increased in size and finally broke out, leaving a rather large ulceration. Two months later, when I examined her, several ulcers were present on both legs, of irregular shape, thick margins, rather deep, and without much secretion; the left tibia was arching forward; moreover, on one of the ribs an indolent gumatous-like swelling was present. In the secretion of the ulcers no spirochætes were found. The girl has been treated with potassium iodide, and the ulcers have healed leaving large whitish irregular scars.

Case II. Singhalese girl of about 11 years of age, sister of the previous patient. No history of syphilis; genital organs intact. Five years ago suffered from yaws at the same time as her sister. She recovered, and remained in good health till three months ago, when an ulcerative process developed on the soft palate which, at the time I examined her, had already destroyed the uvula. The patient presented the thickenings of the metacarpal bones and phalanges which had caused a certain distortion in the right hand. The potassium iodide treatment was begun two months ago, and the patient is rapidly improving. The ulcerative process of the palate being already arrested and healed. No spirochætes were found in the ulcer.

PATHOLOGY.

The histo-pathology of the disease has been thoroughly investigated by Unna, Jeanselme, MacLeod. I have come to the same conclusions. The lesions of yaws must be considered to be granulomata. There is a very diffuse plasma cell infiltration, the plasma cells retaining their original type better than in any other granulomata. The proliferative changes are very well marked; the papillæ are much elongated, their blood vessels being dilated but rarely thickened.

When the yaws have reached a certain stage a very well marked hyperkeratosis is noticeable. I would call attention to the appearance of films taken in the usual way from yaws granulomata and stained according to Leishman's method. In such films it is interesting to note the presence of a large number of polychromatic red blood cells of very different sizes; some much larger than the normal erythrocytes—some much smaller. They are stained deep or light blue instead of pink, and sometimes have a granular appearance. The leucocytes present in the films frequently contain in their protoplasm, and sometimes in their nuclei, roundish or oval, more or less deeply-stained bodies, which I believe to be probably polychromatic micro-erythrocytes engulfed by phagocytes.

ETIOLOGY.

Historical.—Various bacteria have been described in yaws; Eijkman found some peculiar bacilli; Pariez observed numerous micrococci; Powell, in 1896, cultivated in two cases a yeast which was present in the granuloma and also between the epithelial cells.

Nicholls and Watts, in 1899, found in the granulomata a coccus, which they cultivated in pure cultures. The same coccus was found once in the lymphatic glands. Inoculation into animals did not succeed.

In February, 1905, an extremely delicate, almost invisible spirochæte, or spirillum as I thought at that time, was observed by me in a case of yaws. Schaudinn's discovery of a spirochæte in syphilis, published soon after, induced me to work at the subject in a systematic manner. A preliminary note on the presence of spirochætes in yaws was published by me on June 17th, 1905, in the journal of the Ceylon branch of the British Medical Association; another communication was made by me at the meeting of the British Medical Association, Leicester, July, 1905. Several more cases of yaws showing spirochætes I described in the "British Medical Journal" of November 18th and 24th, 1905; at that time I had 11 positive cases out of 14. My results were confirmed by Wellman in one case ("Journal of Tropical Medicine," December 1st, 1905), and by Powell in another ("British Medical Journal," December, 1905). Further researches of mine appeared in the "Journal of Tropical Medicine," January 1st, 1906, and Deutsch. Mediz. Woch., January, 1906, No. 3. Recent publications by various authors confirm the presence of spirochætes in yaws; among these publications one of the most important is by Borne, who has found spirochætes in nine out of 11 cases. (Geneeskundig Tijdschrift, 1906). Recently Borne has informed me by letter that he has been able to detect spirochætes in 49 cases out of 52.

SPIROCHÆTE PERTENUIS (Castellani, June, 1905), seu SPIROCHÆTE PALLIDULA
(Castellani, November, 1905).*

In non-ulcerated papules, and sometimes also in ulcerated lesions of yaws, there is found an extremely delicate organism which morphologically can scarcely be distinguished from the spirochæte of syphilis. The organism takes up generally a pale reddish tint when stained by Leishman's or Giemsa's method. It is extremely thin, some individuals are, however, thicker and better stained than others, though always much thinner than any spirochæte of the refringens and obtusa types. The extremities are often pointed, but due, possibly, to the manipulation of the films, forms may be met with presenting blunt extremities or one extremity blunt and the other pointed. In a few individuals one of the extremities may present a rather large, roundish, pear-shaped expansion, or a loop-like formation. The length varies from a few microns to 18 and 20 microns and even more. The number of waves varies also, but they are generally rather numerous, uniform and of small dimensions. Sometimes a portion of the spirochæte shows numerous narrow uniform waves, while the rest of it has no waves at all. Sometimes, also, two spirochætes may be attached together or apparently twisted the one on the other. Two organisms close together and nearly parallel but united at one end, have been seen. In several individuals I have observed a few chromatoid dots here and there.

TECHNIQUE TO BE USED TO DETECT THE SPIROCHÆTE PERTENUIS.

Films are made in the usual way from scrapings of the eruption. It is advisable to select lesions in which a secondary pyogenic infection has not yet taken place. Giemsa's stain gives good results, but Leishman's method gives also very good results, if the staining is done according to the following instructions:—

1. Let the alcoholic solution of Leishman act for five minutes without fixing the films previously.
2. Mix the stain with equal or double amount of distilled water and let it act for from one half-hour to several hours.
3. Wash with distilled water and leave a few drops of it on the films as usual for from one half-minute to a minute.
4. Blot and examine with very high power.

BACTERIOLOGICAL FLORA FOUND IN OPEN SORES OF FRAMBÆSIA.

The ulcerated lesions of frambæsia are invaded very quickly by all sorts of germs. Besides innumerable bacteria, often spirochæte of various kinds are present, one form is rather thick, and takes up easily the stain; it is morphologically identical with the *Spirochæte refringens* of Schaudinn. Another form is thin,

* In the "British Medical Journal" of November 26th, 1905, I suggested the name *Spirochæte pallidula* for the yaws spirochæte, on account of its resemblance to the spirochæte found in syphilis: according, however, to the laws of nomenclature, the correct zoological name is *Spirochæte pertenuis*, which term I had used some months before ("Journal of the Ceylon Branch of the British Medical Association," June 17th, 1905).

delicate, with waves varying in size and number, and with blunt extremities; I proposed for this variety the name of *Spirochæte obtusa*. A third form is also thin and delicate, but is tapering at both ends; I named it *Spirochæte acuminata*. The *Spirochæte pertenuis*, as found in non-ulcerated lesions, may also be present:

* * * * *

INVESTIGATIONS ON SYPHILIS AND YAWS.

My personal experiments* on the subject prove:—

1. Monkeys are susceptible to yaws. The skin eruption in the monkeys I have experimented with (*S. priamus*, *M. pileatus*) is, as a rule, localized to the seat of inoculation, but the infection is general as is proved by the presence of the *Spirochæte pertenuis* in the spleen and lymphatic glands.

2. The extract of yaws material containing the *Spirochæte pertenuis*, but, so far as our present methods of investigation permit us to say, no other germ, is infective to monkeys.

3. The extract of yaws material from which the *Spirochæte pertenuis* has been removed by filtration, becomes inert.

4. The inoculation of blood of the general circulation and spleen blood taken from yaws patients into monkeys may give positive results.

5. The inoculation of the cerebro-spinal fluid of yaws patients is negative.

6. Monkeys successfully inoculated with yaws do not become immune for syphilis.

7. Monkeys successfully inoculated with syphilis do not become immune for yaws.

8. By means of the Bordet-Gengou reaction, it is possible to detect specific yaws antibodies and antigen.

9. Yaws antibodies and antigen are different from syphilitic antibodies and antigen.

10. The presence of the *Spirochæte pertenuis* in monkeys experimentally inoculated, as well as in yaws patients, is practically constant in the unbroken eruptive elements. It is frequent in the spleen and lymphatic glands.

11. Yaws is generally conveyed by actual contact, but under certain circumstances it may be conveyed by flies, and possibly by other insects.

DIFFERENTIAL DIAGNOSIS.

Verruga Peruana.—This disease is strictly limited to certain valleys of the Andes at an elevation of from 3,000 to 10,000 feet. It is far more fatal than yaws, the mortality rising to 30 and 40 per cent. It is often accompanied by severe fever of long duration; the eruptive elements of *Verruga peruana* attack often the various mucosæ and bleed with great facility.

Bubas.—This disease, found in Brazil and other South American countries, is very different according to Breda and other authors from frambœsia. These authors state that in contrast to yaws the buba lesions do not present any pruritis, and are very often found in the internal mucosæ; the disease is more common in adults than in children. Chronicity is one of its features; mercury and potassium iodide have, according to Breda, little or no effect on the malady. Recently, however, Rivas, after a complete investigation of the disease, has come to the conclusion that bubas is identical with yaws, and that it is caused by the same organism, viz., the *Spirochæte pertenuis*.

Syphilis.—The theory according to which yaws is a form of syphilis, has now only an historical interest. The results of experimental investigations on yaws and syphilis prove clearly that the two diseases are different inasmuch as:—

1. Monkeys successfully inoculated for yaws do not thereby become immune for syphilis, and vice-versa.

2. The yaws antigen and antibodies have been proved to be different from syphilis antibodies and antigen.

Syphilis is practically pandemic; yaws, on the other hand, is localized to some parts of the tropics. Yaws is extremely common in Ceylon, extremely rare in

* NOTE.—The details of these experiments are left for subsequent publication at the author's discretion.

India. Syphilis is common in both countries. In Samoa, according to Turner, syphilis was unknown up to at least 1880, while yaws has been endemic there ever since the group was discovered. In Fiji, too, up to a few years ago, syphilis was not present, while yaws was almost universal. Daniels has made the interesting observation that in British Guiana yaws of late years has disappeared, while syphilis is still rampant. As regards clinical features, yaws presents the following symptoms in contrast to syphilis: primary lesion generally extra genital, principal type of eruption a papule which proliferates into a papillomatous growth; extremely well marked pruritus.

The histo-pathology of yaws and syphilis, as pointed out by Macleod, Unna, &c., is somewhat different; in yaws the proliferative changes of the epidermis are much more marked, the yaws granulomata present a more diffuse plasma cell infiltration, and their blood vessels have no tendency to thickening.

PROGNOSIS OF YAWS.

The prognosis is not serious *quoad vitam*. In Ceylon in 1905, 3,535 cases were treated, with 25 deaths; in 1904, out of 3,591 cases, 16 died; in 1903, out of 3,254 cases, 10 only died. The prognosis is much more serious in children than in adults.

When the disease ends fatally it is generally due to the ulcerated lesions becoming phagædenic, and to septicæmic and pyæmic processes. Though framboesia rarely terminates in death, its long duration and great contagiousness make it a serious complaint. The patients suffering from it are not able to attend to their work; epidemics of yaws, therefore, acquire great importance in plantations of sugar, tea, &c., as they greatly reduce the supply of labour.

Prevention of Yaws.—The slightest abrasions of the skin should be taken care of and properly treated with antiseptics in countries where yaws is endemic. The yaws patients should be prevented from mixing with the rest of the population, and should be isolated in special hospitals till the disease is cured; their huts and belongings should be thoroughly disinfected.

TREATMENT.

The natives treat the disease in various ways; in Samoa the patient is rubbed down with sand and washed in the sea, and then the yaws are scraped with a shell. In the West Indies boiled and beaten-up leaves of the "physic nut" are applied, or powdered alum and sulphur used.

In Ceylon the *vederales* (native doctors) apply concoctions of various herbs, and give decoctions of sarsaparilla and other roots. They use also mercury disguised in various ways. The majority of European practitioners use mercury and potassium iodide; others affirm these drugs to be quite useless, and believe that cleanliness and good and abundant food are quite sufficient to bring about a cure.

In the Colombo Clinic for Tropical Diseases I have made some experiments on the various treatments, and I have convinced myself that the potassium iodide treatment is the most effective of all. I do not deny that some mild cases may recover spontaneously, but this is certainly the exception, and not the rule. I kept, on purpose, four typical cases of framboesia without any treatment for a certain time. One remained stationary—the other three became worse and worse. In one of these—a woman—for humanity's sake I had to give up the experiment after four weeks, numerous large fungoid ulcerations having developed. The symptom of which she complained the most, and for which she was continually begging some remedy, was the unbearable pruritus. As soon as the potassium iodide was administered this symptom decreased remarkably in intensity, and finally disappeared, the eruption also getting better.

The potassium iodide should be given in large doses (at least grms. 3 to 4 daily); I have little doubt that many reported failures of the treatment are due to the insufficient quantity of iodide administered. The yaws patients bear large doses well; when severe symptoms of iodism set in the doses should be temporarily decreased or the treatment may be stopped altogether for a few days. Mercury is useful in many cases, especially in children, but it is far less efficient than the iodides.

Local treatment consists chiefly in keeping the skin scrupulously clean, washing the eruption twice daily with a perchloride of mercury solution (1 in 1,000), which

greatly allays the itching. The ulcerated lesions may be dusted with iodoform, boracic acid, &c. Mercury ointments may be beneficial, but in my experience are not sufficient to hinder secondary pyogenic infections.

Caustics are not called for unless the ulcers become phagœdenic; in such cases pure carbolic acid is the best. Though the external treatment may be useful, one must bear in mind that it is not, as a rule, sufficient alone to cure the disease.

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Enclosure 2 in No. 3 in Appendix VII.

THE OPSONIC TREATMENT OF SOME DISEASES IN THE TROPICS, by ALDO CASTELLANI, M.D., Director of the Clinic for Tropical Diseases, Colombo.

TECHNIQUE.

I have closely followed the methods given by Wright and Douglas. The opsonic index of the patients was regularly taken before each vaccine injection. As is well known from the classical researches of Wright and Douglas, when a vaccine is introduced into an animal the immediate effect on the blood is a lowering of the resisting power to the organism in question. This phase, called "negative phase," is soon followed by a "positive phase," when protective substances are elaborated and the resisting power of the blood rises. It is generally admitted that no further injections should be given during the negative phase; I followed this rule, making

occasionally an exception in the case of patients of strong physique, and when suffering from localized affections only. I have always prepared the vaccines direct from the germs isolated from the patients. The following is the technique I have used: the germ is grown on agar tubes for 48 hours; then 10 normal loopfuls (one loopful—mmgr. 2) are mixed with 10cc. of sterile normal salt solution or sterile pepton water. The emulsion is then heated to a temperature ranging from 60 to 65 for one hour. After this the vaccine is ready for use; but I generally add $\frac{1}{2}$ cc. of carbolic acid. It is advisable to keep the vaccine in a cool, dark place. Following the method of preparation I have described, each cubic centimetre of the liquid will correspond to one loopful (2 mmgr.) of culture. I generally begin by giving only $\frac{1}{4}$ cc. of vaccine and gradually increase to $\frac{1}{2}$ cc. and $\frac{3}{4}$ cc. I have never exceeded the dose of 1cc. per injection.

DISEASES TREATED.

Pseudogranuloma pyogenicum.

Singhalese boy, 5 years of age. Admitted to the clinic on December 19th, 1906. The patient presented on the face, arms, and legs several peculiar elevated granulomatous looking patches, half an inch to one inch in diameter. These patches were oval or roundish and of a pinkish colour, some were covered with a thin yellow crust—on removing which a little purulent secretion was found. The patches presented a distinct granulomatous appearance, and on a superficial observation, might have been mistaken for yaws. The *Spirochæte pertenuis*, however, was absent. A biopsy was made; bits of the tissue were imbedded in paraffine and sections stained with Pappenheim's method: no plasma cells could be seen, therefore the lesions could not be considered to be true granulomata. From the patches a *Staphylococcus pyogenicus aureus* was grown, from which a vaccine was prepared. Of this vaccine the child was given eight injections at various intervals within four weeks. The opsonic index rose from 0.60 before the treatment began, to 1.3 after the 4th injection; the patches gradually disappeared within three weeks.

Coccogenic sycosis.

Singhalese clerk, out-patient. All the well-known typical features of the affection were present. The patient had tried various treatments, including epilation, with only temporary benefit.

Bacteriological examination of the posules: *Staphylococcus aureus* and *albus* present.

Opsonic index to staphylococci 0.70.

One injection ($\frac{1}{2}$ cc) of a mixed staphylococcus vaccine prepared from the strains isolated from the patient, was given; after five days the opsonic index had not risen at all; I decided, however, to give another two injections of the same amount of vaccine. Three days after the second injection the opsonic index was 0.80. Two more inoculations were given a week later; no external treatment of any sort—with the exception of the application of a boric solution occasionally; no epilation. The patient became much better very soon after the second injection, and was practically cured a week after the third injection.

Pseudogranuloma pyogenicum and coccogenic sycosis.

Malay constable admitted to the Police Hospital on the 14th December, 1906, by Dr. La Brooy, who very kindly allowed me to treat the case and in every way facilitated my researches. The patient had numerous postules and yellow crusts on the chin; each postule being pierced by a hair. The hairs were easily pulled out. The microscopical examination did not show the presence of any trycophyton, but only of cocci. Plates were made and a *Staphylococcus aureus* was grown in pure culture. The patient, besides this form of sycosis, presented a peculiar, large, pinkish, granulomatous-looking patch, not covered by crust, on the apex of the nose. Several similar patches, but of smaller dimensions, were on the cheeks, and two or three on the arms, and a few on the legs; on superficial examination these granulomatous-looking patches might have been taken for yaws granulomata. The histological examination did not reveal the presence of plasma cells. From the granulomatous-looking patch on the nose, a *Staphylococcus aureus* in pure culture was grown, identical with the staphylococcus found in the sycosis pustules. No spirochætes were present.

Opsonic index for *Staphylococcus aureus*: before starting the treatment 0.60.

An inoculation of a staphylococcus vaccine prepared from the strain grown from the pseudogranuloma of the nose, was injected under the skin of the shoulder. There was no fever after the inoculation, and the patient felt well: he complained for a few hours only of some slight pain at the point of inoculation. Five days later, when I next saw the patient, the eruption was strikingly better, the sycosis postules having practically disappeared, and the pseudogranulomatous patches having become much smaller and drier. Opsonic index to *Staphylococcus aureus* 0.95. A second injection was given. Dr. La Brooy has informed me that the eruption dried up completely and disappeared, the patient leaving the hospital a few days later.

Peculiar purulent folliculitis of the legs.

In natives going about with their legs uncovered I have noticed several times a peculiar papular-pustular eruption involving the hair follicles, which is most difficult to cure with ordinary methods of treatment. From the pustules the *Staphylococcus aureus* and *Staphylococcus albus* are easily grown.

In two such cases I tried the opsonic treatment, using a mixed staphylococcus vaccine. The result in both cases was very good, the postules having totally disappeared after four injections.

Acne Vulgaris.

Case I. European; young man of 22 years of age. Consulted me on the 15th April, 1906, for an obstinate form of acne vulgaris of the face, from which he had been suffering for more than four years. He had undergone various treatments which had given only temporary relief. From one of the postules *Staphylococci albus* and *aureus* were grown. Opsonic index 0.65 to staphylococci. On April 29th a staphylococcus vaccine injection was given ($\frac{1}{2}$ c.c.) in the region of the shoulder. Opsonic index 24 hours afterwards, on April 30th, 0.50.

Opsonic index on 5th May, 0.80. On this date another injection, same dose, was given. The patient had a rise of temperature (100) at night and complained of malaise for a few hours. A week later the opsonic index to staphylococci was 1.2. The patient was better though the postules continued to develop. Four more injections were given at various intervals during May. At the end of May the treatment had to be discontinued, the patient going to Europe. When the patient left the eruption was better—though certainly not cured. According to the patient the opsonic treatment induced a much greater improvement than any other method of treatment he had had recourse to before.

Case II. European, aged 25. Consulted me in May, 1906. Chronic acne of the face and back. Opsonic index to staphylococci 0.50. The opsonic index rose gradually to 1.2 after three injections of $\frac{1}{4}$ cc. and three of $\frac{1}{2}$ cc., at various intervals within two months. The improvement was not, however, very marked, several postules continuing to appear.

Furunculosis.

Young European of 27 years of age. Consulted me on the 16th June, 1906. He had been suffering from large, very painful boils on the legs and arms for several weeks; lately there had been some irregular rises of temperature, accompanied by slight shiverings. Two of the larger boils were opened; from the pus the *Staphylococci aureus* and *albus* were grown.

Opsonic index to staphylococci, 0.50.

An injection of only $\frac{1}{4}$ cc. of mixed staphylococcus vaccine was given. The day after, the opsonic index was as low as 0.40; the third day, 0.50; the fifth day, 0.70. A second injection ($\frac{1}{2}$ cc.) was then given, and a third ($\frac{3}{4}$ cc.) a week later. The opsonic index rose to above normal. The boils gradually disappeared within three weeks after the commencement of the treatment.

Chronic Bacterial Dysentery.

I was consulted, on April 20th, 1906, by a French gentleman coming from China, who had been suffering for six months from dysentery. He had had in China, a very sharp attack, which lasted two weeks. Since that time he had had every now and then diarrhoea with bloody stools and tenesmus. He had been treated with salines, ipecaquana, bismuth, &c., without any lasting improvement. When I saw him he was passing from four to six stools daily, containing very little faecal matter, much muco-pus and a little blood.

Microscopical examination: numerous leucocytes, a few red cells, no amœbæ.

Bacteriological examination: the Kruse-Shiga bacillus was isolated.

Having in my possession some anti-dysenteric serum, prepared at the Lister Institute, London, which had given me very good results in two cases of acute bacterial dysentery, I inoculated the patient with it on three consecutive days. No change. I then prepared a vaccine, using the strain of Kruse-Shiga bacillus isolated from the stools. The first time I inoculated $\frac{1}{4}$ cc.; the second time, four days later, $\frac{1}{2}$ cc.; the third time, eight days later, 1cc.

The first inoculation caused a slight rise of temperature (100.4 Fahr.), which lasted a few hours. The blood and pus disappeared from the stools within six days, the number of stools falling to two feculent motions daily.

The patient was obliged to leave Ceylon, and could not, therefore, be watched any longer. He wrote to me, however, three months later from Egypt, stating that so far he had not had any more attacks, while previously he had had at least two every month.

One cannot, of course, come to a conclusion as regards the efficacy of the opsonic treatment in dysentery from the experience of a single case: it may simply have been a phenomenon of coincidence. Dr. Gray, however, in Kasauli (India), informed me orally (August, 1906) that he also had independently treated a case of chronic dysentery with the opsonic treatment, with very good results.

Quite recently (March, 1907) I have had opportunity to treat another case of chronic bacterial dysentery, with very good results.

CONCLUSIONS.

To sum up, I have used the opsonic treatment in 11 cases of various bacterial diseases, viz. :—

One case of pseudogranuloma pyogenicum.

One case of pseudogranuloma pyogenicum and coccogenic sycosis.

Two cases of acne vulgaris.

Four cases of purulent folliculitis of the legs.

One case of furunculosis.

Two cases of chronic bacterial dysentery.

The results have been extremely satisfactory with the exception of the two cases of acne, one of which improved but was not cured; the other showed practically no improvement.

No. 4 in Appendix VII.

CEYLON.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received November 11, 1907.)

MY LORD, The Queen's House, Colombo, Ceylon, October 23, 1907.

I HAVE the honour to forward the following reports, furnished by Dr. Castellani, Director of the Bacteriological Institute, Ceylon:—

(1) Treatment of elephantiasis.

(2) *Tinea inter-secta*.

(3) *Microsporosis rosea*.

I have, &c.,
HENRY McCALLUM,
Governor, &c.

Enclosure 1 in No. 4 in Appendix VII.

(1.)

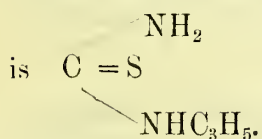
OBSERVATIONS ON THE TREATMENT OF ELEPHANTIASIS by ALDO CASTELLANI, M.D.,
Director of the Clinic for Tropical Diseases, Colombo (Ceylon).

Elephantiasis is considered to be an incurable affection, apart from those cases where it affects the scrotum or forms localised pendulous tumours which may be treated surgically. I have for some time past made experiments with the object

of devising a palliative treatment for this disease, which is extremely common in some parts of the tropics. The first, following the example of my predecessors, I have tried the injections of various antiseptics with the idea to destroy the organism which is the cause of the disease. The chemicals I experimented with were the following:—

- (1) Methylene blue, given by the mouth as well as by subcutaneous injections.
- (2) Solutions of hydrargyrum perchloride, carbolic acid, cyllin, and other antiseptics given hyperdermically.
- (3) Various arsenical compounds: cacodylate of soda, of quinine, &c., given by the mouth and by subcutaneous injections.

The result of the investigation was negative, and not the slightest improvement was ever noticed in any case. It then occurred to me that one of the anatomical features of elephantiasis being the enormous increase of the fibrous tissue, thiosinamin might be useful in the treatment of the disease. It is well known that thiosinamin, according to Hebra, Van Boorn, Langemann, &c., has the power of softening various kinds of fibrous tissue facilitating its absorption, though the intimate mechanism of this action is not known. Thiosinamin was discovered in 1828 by Berzelius. It is obtained by treating two parts of mustard essence with one part of absolute alcohol and seven parts of ammonia; heating at 40 for several hours and then slowly cooling. The chemical formula of thiosinamin



The crystals of thiosinamin have a bitter taste, an odour of garlic, are easily soluble in alcohol and ether, but not in water.

Thiosinamin, in addition to its peculiar softening action on various fibrous tissues, has also some antiseptic properties. Thiosinamin injections are very painful; I have, therefore, used fibrolysin, which is a water soluble combination of thiosinamin with sodium salicylate, prepared by Mendel and manufactured by Merk. Fibrolysin can be obtained in sterile glass ampullæ, each containing 2cc. of liquid, corresponding to 0.2 grains of thiosinamin.

I may state at once that the simple injection of thiosinamin without rest, massage, and, most important of all, proper systematic bandaging, does not induce any marked improvement.

Technique of the Treatment.

The patient is first kept at complete rest in bed for a week, the affected parts being bandaged with flannel or india-rubber bandages, and massaged regularly twice daily. After these manipulations, the affected parts, while not showing much improvement as regards size, become somewhat softer. Then I begin injecting thiosinamin. I make the injections in various parts of the affected regions, using the ordinary antiseptic precautions. I use an antitoxin syringe supplied with a strong needle. A sterile pad of gauze is applied at the place of the injection, and the whole limb is tightly bandaged with flannel bandages. To increase the pressure, pads of inelastic material, like gauze or boiled cotton-wool, may be applied on the more prominent or harder parts before bandaging. In some cases an elastic rubber bandage is applied for one hour, two or three times daily over the flannel bandages or directly over the skin.

The injections are almost painless; after two or three hours there may be a little local pain, and the following day the part may feel harder than before, but, in the successful cases, after two or three days the spot where the injection was made and the parts surrounding it become softer. As regards dosage, I generally inoculate 2 cc. of fibrolysin every day or every other day, according to the features of the case, for about a month; I then discontinue the injections for a week, during which time I continue the use of flannel and indiarubber bandages. The indiarubber bandaging is most useful in cases of verrucose elephantiasis; it has no action on the deep lesions of the disease, but it renders the skin much smoother, the hard verrucose-like projections disappearing or becoming smaller; the disappearance of the hard, corneous formations is facilitated by applying before bandaging a spirit lotion containing resorcin and salycilic acid, 10 grains of each to the ounce of rectified spirit. After a week or 10 days, a second course of 30

or more injections is given; then again a week's rest with rubber bandaging followed by another course of injections. It is to be noted that, while the use of rubber bandages is very beneficial in verrucose elephantiasis, it is of very little advantage, and occasionally may be harmful, in those cases of elephantiasis which present a smooth skin.

After this treatment the affected parts, in successful cases, are of much smaller size; though the enlargement of the bones, so frequently found, does not decrease, the skin becomes softer, more elastic, and can be pinched up in folds. At this stage, when most of the subcutaneous tissue has been absorbed, I suggest the surgical removal of the portions of the redundant skin. When the disease affects the legs, long elliptical strips of skin and subcutaneous tissue are removed and the margins of each wound stitched together. This would not be practicable before the medical treatment, as the skin being enormously thickened and inelastic the coaptation of the opposed surfaces would not be practicable.

When the wounds have healed the patient is advised to wear elastic stockings and every night for one hour an elastic bandage.

Elephantiasis verrucosa of the Right Leg.

Case 1.—Ganegada Singhappu, Singhalese lad, aged 18, admitted to the Clinic, January 2nd, 1907. First symptoms of the disease appeared 12 years ago, when he suffered from repeated attacks of fever, accompanied by painful temporary swelling of the right leg. Later on the enlargement of the leg became permanent, increasing gradually to such an extent that the patient had to give up his work—he was an indoor servant.

At the time of admission the whole limb below the knee was greatly enlarged, the skin being thickened, hard, and rough. On the dorsum of the foot and toes numerous horny hard prominences were present. The limb measured round the ankle $23\frac{1}{2}$ inches, round the calf $25\frac{1}{2}$ inches. The inguinal glands were not enlarged, the scrotum and the left leg were not affected. No filaria was found in the blood. The patient was first kept in bed for two weeks with the right leg slightly elevated and tightly bandaged with flannel bandages. Massage was done twice daily. At the end of the two weeks the parts were slightly softer, but the dimensions of the leg were practically the same. The thiosinamin treatment was then started, using the precautions already mentioned.

The patient received 62 injections altogether. During the last period of treatment the limb was very tightly bandaged for one hour three times daily with a rubber bandage. At the end of the course of injections, the condition of the affected leg was strikingly improved, the circumference round the ankle being reduced to $9\frac{1}{2}$ inches, round the calf to 12 inches. Moreover, the skin had become soft and of almost normal elasticity.

The patient, finding himself so much improved, able to walk easily, whereas when admitted he could scarcely move without help, asked to be allowed to leave the clinic temporarily and go to his village, where he wished to transact some business. I told him to use a flannel bandage continuously and to come back to the clinic at the earliest date. He returned two weeks later, confessing that he had never used the bandages supplied to him. The lower part of the leg and foot were much enlarged (circumference round the ankle 12 inches), œdematous and soft. After 24 hours of complete rest in bed and rubber bandaging the swelling disappeared and the measurements of the limb gave the same results as when he had left.

The patient remained in the Clinic several weeks more without having any more thiosinamin injections; the use of a rubber bandage was, however, regularly continued; the size of the leg increased very slightly. In July I advised him that long elliptical strips of the redundant skin should be removed. I asked Dr. Paul, Surgeon to the General Hospital, to perform the operation, which he very kindly consented to do. The operation was performed on the 20th July. The patient was given chloroform, and, after a thorough disinfection, a long elliptical strip of the skin and subcutaneous tissue was removed from the anterior part of the leg and dorsum of the foot. The margins of the wound were brought into contact by means of an interrupted suture.

The stitches were removed after 11 days. The wound healed rapidly.

Three weeks later another strip of skin was similarly removed from the posterior region of the leg. This wound also healed quickly. The patient left the hospital in the latter part of August, but has been seen by me regularly. So far, two months after the first operation, the leg is not enlarged. The patient has been

regularly wearing an elastic stocking and at night he uses a rubber bandage for an hour after having done some massage. If he does not wear the elastic stocking, and does not do the bandaging, the lower part of the leg becomes somewhat swollen and œdematous, though far less so than before the operation.

Case 2.—The patient, a private case, consulted me in October, 1906. He was suffering from elephantiasis of the right thigh, leg, and foot, of 20 years' duration. The skin of the lower part of the leg and foot was extremely hard, inelastic, and covered with numerous small wart-like protuberances.

Measurements.—Round the ankle $24\frac{1}{2}$ inches, round the calf 27 inches, round the thigh 25 inches.

The patient underwent a treatment of 90 thiosinamin injections combined with complete rest in bed and the use of flannel bandages at first and indiarubber bandages later. The case improved greatly, the skin becoming softer, more elastic, and much smoother. The circumference round the thigh was reduced to 21 inches, round the calf to 16 inches, and round the ankle to $14\frac{1}{2}$ inches. The patient was able to walk with much greater ease. The patient, following my instructions, has been wearing puttees, and has continued regularly the use of the rubber bandaging twice daily for an hour; he states that if he stops the bandaging and the wearing of puttees, even for two or three days, the leg becomes swollen and œdematous; the swelling disappears, however, after a few hours' rest and bandaging. He declined to have the operation performed. He has not been seen by me lately.

Elephantiasis of the Left Leg.

Case 3.—The patient, a private case from India, had elephantiasis of 15 years' duration, confined to the lower part of the left leg and foot. He underwent a course of 56 thiosinamin injections, combined with rest, massage, and the use of the rubber bandages. The improvement was very slight, the skin became somewhat smoother, but the dimensions of the affected parts remained practically the same. I think that rest, massage, and bandaging alone, without the injections, would have induced the same improvement.

Case 4.—Singhalese woman, aged 56, admitted to the Clinic, April 2nd, 1907. The disease is of 15 years' standing and is localised in the lower two-thirds of the left leg and in the foot. The skin was thick and inelastic, but not so rough as in the other cases.

Circumference round the ankle 19 inches. The woman was kept in bed for 10 days and the parts bandaged with flannel bandages; skin softer, but dimensions of the limb practically unchanged. I then commenced the thiosinamin injections. She left the Clinic at her own request after having received 35 injections, wishing to visit her family in a distant village. She was better, the dimensions of the foot and leg having greatly decreased. When the patient was admitted to the Clinic she could not move her toes; on leaving such movements could easily be made.

Case 5.—Bennet Gregory, Singhalese boy, aged 10 years, admitted to the Clinic on June 25th, 1907. Three years ago the patient began suffering from attacks of fever with contemporary swelling of the left leg and lymphatic inguinal glands of the left side. On admission the left leg and foot were greatly enlarged, the skin being thick and hard, but with a smooth surface. Lymphatic inguinal glands of the left side were slightly enlarged and hard. The maximum circumference round the calf was $14\frac{1}{2}$ inches.

Treatment was begun on June 28th, 1907. He received 25 injections and the limb was regularly tightly bandaged with flannel bandages, and for an hour every other day with rubber bandages.

On July 23rd the injections were discontinued; they were resumed on the 29th of the same month. During the interval only massage and the use of rubber and flannel bandages was continued.

After the first 12 injections a distinct improvement was noticeable, the parts becoming softer and the size of the limb decreasing.

On July 15th and 16th, however, the affected parts again became enlarged and very hard, though there was no fever. This condition lasted for three days, when on the 17th the improvement recommenced and steadily continued. At the time of writing (October 1st, 1907) the improvement is well marked, the maximum circumference round the calf being 8 inches. The skin is much more elastic and

in some parts can be pinched up in folds. I hope it will soon be possible to perform the same operation as in Case 1.

Elephantiasis verrucosa of the Right Leg.

Case 6.—Vekanda, Singhalese man of 40. Admitted to the Clinic on the 3rd September, 1907.

The disease is of 15 years' standing. The right leg and foot are enormously enlarged, the maximum circumference round the calf being $28\frac{1}{2}$ inches, the skin is thick, inelastic, and covered with numerous hard corneous projections. The lymphatic glands of the right side are enlarged and hard. The scrotum is not affected.

Blood.—Numerous *eosinophiles* (15 per cent.), no *filaria nocturna* (Manson).

Treatment was begun on the 9th September, 1907, the patient has received up to the present time (1st October, 1907) 20 thiosinamin injections. The whole limb has been regularly bandaged with flannel and rubber bandages. The case is improving, the maximum circumference round the calf being now $19\frac{1}{2}$ inches. The skin is somewhat softer.

I propose continuing this treatment for three months more and then, if the skin shall have become elastic, the same operation will be performed as in Case 1.

Conclusions.

1. The treatment I have devised for elephantiasis, viz., thiosinamin (fibrolysin) injections and methodical bandaging, followed by the removal of portions of the redundant skin when most of the subcutaneous tissue has been absorbed, is of utility in a certain number of suitable cases.

2. On the mode of action of the treatment I am not yet in a position to give any definite explanation. Probably thiosinamin acts by softening the fibrous tissue so abundant in elephantiasis; possibly the antiseptic properties of thiosinamin, though very slight, may play a rôle. An observation which, if confirmed, may throw some light on the question is that, in the majority of my cases, the thiosinamin injections induced a fairly well-marked, though transient, leucocytosis; in one case (Case 1) the number of leucocytes rising from 9,000 to 7,500 per centimetre. It is to be noted that the thiosinamin treatment without a constant well-distributed pressure on the affected parts, best obtained by careful bandaging, does not cause any marked improvement; similarly constant pressure on the affected parts by means of bandaging as well as massage has, without thiosinamin injections, practically no effect whatever on the disease.

ALDO CASTELLANI.

Colombo (Ceylon),
October 1, 1907.

Enclosure 2 in No. 4 in Appendix VII.

TINEA INTERSECTA by ALDO CASTELLANI, M.D.

I have had the opportunity to investigate, in Ceylon, two cases of a peculiar dermato-mycosis, which, so far as I know, has not yet been described, and for which I suggest the name of *Tinea intersecta*. Both patients were Tamil; in one the eruption developed while he was convalescent from typhoid fever. The eruption showed identical characters in both patients and ran the same course. Small oval, or roundish, very slightly elevated, itching spots appeared on the skin of the arms, chest, and back; in the second patient on the legs also. The margins of these patches were occasionally slightly raised and dotted with tiny papules. The patches were dark brown, much darker than the surrounding skin, and presented a smooth tense surface at first; they increased in size slowly and some coalesced. After a certain time the surface of the patches is no longer tense, it becomes somewhat shrivelled and dry, superficial cracks appear so that white lines

are visible intersecting the brown surface of the patches; later the cracks become deeper, the epidermis splits, and several flaky curled up scales, whitish inside and dark on the outer surface, are seen; the scales are often removed by friction, &c., and whitish roundish patches only may remain.

The eruption never develops in concentric rings like *Tinea imbricata*, the patches remain isolated or fuse together forming irregular larger patches. Some patches may disappear spontaneously after a time. The general health of the patient does not seem to be at all affected; in both my patients a slight degree of eosinophilia, 8 per cent. in one case and 6 per cent. in the other, was present. The eosinophilia may, however, have been due to the intestinal worms which both patients harboured, as shown by the examination of the stools, which contained ova of *ascaris lumbricoides* and *trycocephalus dispar*.

The Fungus.—If a portion of one of the brown patches or a scale is removed and treated with liq. potassæ, the fungus is easily detected. The fungus grows apparently between the superficial and the deep strata of the epidermis. The fungus is present on the inner surface of the scales but not on the external surface.

The fungus presents the general characters of a trycocphyton; what is very remarkable is the extreme rarity of free spores. The mycelium is fairly abundant, though far from being so abundant as in *Tinea imbricata*. The mycelium is composed of long straight articulated threads, which are sometimes dichotomous, the breadth being between 3 and 3½ micron. Endospores are present as well as endonoedia.

No aspergillar fructifications nor clusters of spores are seen. So far I have not succeeded in growing the fungus.

Diagnosis.

Pityriasis versicolor.—When the eruption is in the very first stage it might be mistaken for a form of tropical *Pityriasis versicolor*. In pityriasis, however, the epidermis does not split; moreover, in *Tinea intersecta* the fungus is not found on the surface, it grows between the superficial and deep layers of the epidermis.

Tinea imbricata.—The fungus in both eruptions grows between the superficial and deep layers of the epidermis. In contrast to *Tinea imbricata*, however, the eruption of *Tinea intersecta* never develops in concentric circles; is far less severe, as patches may disappear spontaneously, and is cured without any difficulty.

At the time I was studying these two cases of *Tinea intersecta*, I had under observation also several cases of *Tinea imbricata*; the two eruptions could not possibly be confounded.

Treatment.—Tincture of iodine and the usual antiseptic ointments answer well.

ALDO CASTELLANI.

October 1, 1907.

Enclosure 3 in No. 4 in Appendix VII.

MICROSPOROSIS ROSEA, by ALDO CASTELLANI, M.D., Director of the Clinic for Tropical Diseases, Colombo (Ceylon).

During the last two years I have been investigating the various forms of *Pityriasis versicolor* affecting natives and Europeans in the tropics.

In previous publications* I described the following varieties as occurring in the tropics:—

1. A yellow variety, extremely common among natives and occasionally affecting Europeans, which I called *Pityriasis flava*. The yellow colour may be

* British Medical Journal, 1905; Journal of Tropical Medicine, 1907.

of various tinges, from deep dark yellow in some cases to very light canary yellow in others. I named the fungus found in *Pityriasis flava*—*Microsporon tropicum*.

2. *Pityriasis alba*.—This I was at first inclined to consider a sub-variety of *Pityriasis flava*. The fungus, however, has different characters and shows transition forms between a microsporon and a trycophyton. Further investigations will probably show that this fungus, which I named *Microsporon macfadyeniis*, not a true microsporon, nor the eruption, correctly speaking, a form of *Pityriasis versicolor*.

3. *Pityriasis nigra*.—The affected parts are of a black, dull, lustreless colour, much darker than the surrounding dark healthy skin of the native; it occasionally affects Europeans. The affection is caused by a fungus, which I called *Microsporon mansonii* in honour of Sir Patrick Manson.

It is remarkable that while the fungi found in the other varieties of *Pityriasis versicolor*, including the European forms, do not grow in artificial media, the *Microsporon mansonii* grows abundantly on maltose agar, ordinary agar, and other culture media.

The European form of *Pityriasis versicolor* also is found in the tropics; it generally affects Europeans and half-castes.

I am now in a position to describe yet another form of parasitic pityriasis which I have come across among Europeans living in the tropics and which is characterised by its pink-red, occasionally coppery colour. A term which would suit the condition would be *Pityriasis rosea*; as, however, this term is used to denote another well-known skin affection (*Pityriasis rosea* of Gilbert), which is quite unconnected with parasitic pityriasis, I propose the name *Microsporiasis rosea*.

The generic term microsporiasis might be applied with advantage, I think, to other forms of parasitic pityriasis: thus *Pityriasis flava* might be called *Microsporiasis flava*; *Pityriasis nigra* *Microsporiasis nigra*, &c.

Description of Microsporiasis rosea.—My description of the disease is based on the study of four European patients I have seen affected with it. The eruption usually appeared first on the chest, axillary regions, and back; it never involved the face. The eruption consists of roundish or oval patches, not elevated, or only very slightly so. Several of these patches are often found coalesced together so that they form larger patches of irregular outline. The colour of the patches is pinkish, or reddish-pinkish—occasionally coppery, with a fawn tinge; there are no scales, the surface is smooth and tense, rather shiny, or very finely wrinkled, it does not show any desquamation. There is no pruritus, or if there is it is very slight. The superficial lymphatic glands are not enlarged. The blood does not show any abnormality, at least in the four cases I have examined. No eosinophilia. The general health is in no way impaired.

The Fungus.—If one of the reddish patches be scraped and a preparation in liq. potassæ be made, the fungus can be easily detected. It consists of a mycelium and spores. The general characters of the fungus are those of a microsporon. The mycelium closely resembles the mycelium of *Pityriasis flava* and of the pityriasis of temperate zones; the spores have more resemblance to the spores of *Microsporon mansonii*. The mycelial threads are rather thick and often show swellings, constrictions, and other irregularities of shape. The free spores are globular, of rather large dimensions, 5 to 7 microns. So far I have not succeeded in growing the fungus.

Diagnosis.—The conditions with which the disease is most easily confounded is a form of *Seborrhœa corporis*, localised to the chest, very frequent in hot climates. In fact two out of the four patients were sent to me as suffering from *Seborrhœa corporis*, and without the help of the microscope I should have made that diagnosis.

The microscopical examination will also distinguish the disease from *Pityriasis rosea*.

Ringworm.—In contrast to ringworm the disease is practically not pruriginous; it does not develop in circles and the margins of the patches are not sensibly elevated.

Syphilis.—On superficial examination the eruption, especially when it presents a coppery colour, might be confounded with a syphilide. One of my patients con-

sulted me believing he was suffering from syphilis. The absence of other signs of syphilis and the microscopical examination will clear the diagnosis.

Pityriasis flava (*Microsporiasis flava*).—I was at first inclined to consider *Microsporiasis rosea* a variety of *Pityriasis flava*; the difference in colour, however, is striking; moreover, in contrast with *Pityriasis flava* the eruption does not involve the face and is more easily cured.

Treatment.—A salicylic alcoholic lotion (2 to 4 per cent.) followed by a resorcin and salicylic ointment (10 per cent. resorcin and 2 per cent. salicylic acid) generally gives good results.

ALDO CASTELLANI.

October 1, 1907.

No. 5 in Appendix VII.

FEDERATED MALAY STATES.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received July 1, 1907.)

MY LORD,

Government House, Singapore, June 6, 1907.

I HAVE the honour to forward herewith a report on the work done in the Institute for Medical Research during the six months October, 1906, to March, 1907.

I have, &c.,

JOHN ANDERSON.

Enclosure in No. 5 in Appendix VII.

SIX-MONTHLY REPORT OF THE INSTITUTE FOR MEDICAL RESEARCH, KWALA LUMPUR,
FEDERATED MALAY STATES.

During the six months, October, 1906, to March, 1907, a large amount of work has been done on trypanosomiasis as met with in cattle and horses. Mr. Symonds, Acting Government Veterinary Surgeon, has co-operated with me. I append a brief report of the work so far accomplished.

Since January arrangements have been in progress for the initiation of an investigation on the rice theory of beri-beri and the work is expected to commence at an early date.

Various samples of paddy have been analysed for poisonous substances; considerable difficulty has been experienced in this work; it is intended, however, to extend the researches in connection with the preceding investigation.

Upwards of 50 autopsies have been made on cases of dysentery.

The bacteriologist has been engaged on the routine work of his post.

The chemist has done a large amount of medico-legal work and made analyses of various materials submitted to him.

The entomologist has, amongst other subjects, been engaged in the study of the ticks and biting flies.

Trypanosomiasis.

On the 1st September a case of this disease was discovered in an Australian mare (Chart 1)* on Sungei Rengam Estate, Klang District.

* Not reproduced.

Previous outbreaks of this disease have been noted in these States, and, as in many tropical countries the disease has become a serious scourge, it was deemed advisable to make a full investigation of the subject.

At Klang, on the 11th September, a Javanese pony was found to be affected.

The estate at Sungei Rengam is a large one and the mare had not been away from the place since May, that is to say for about three months previous to its being first observed to be sick. There is one other horse, which has remained healthy, on this estate; no other horses are kept within a radius of five miles and no equine was known to have visited the estate.

Bullock carts are common on the road between Klang and Sungei Rengam. The cattle in the Klang District were, therefore, examined for trypanosomes.

On Sungei Rengam Estate there are not many cattle and of these none were found to be affected.

At Batu Tiga, on the 29th September, an Indian bullock and a Siamese bullock were tested by animal inoculation; both were found to be affected. Repeated examination of blood films from these cattle failed to reveal the presence of trypanosomes. Thereafter, so far as possible, suspected cattle were tested by inoculation of their blood into rabbits or guinea-pigs.

On the 23rd September, at Klang, an Australian mare, stabled about a quarter of a mile from the Javanese pony, was found affected.

At Klang, on the 11th October, inoculations were made from four Indian bullocks, one Siamese bullock, and one cross-bred India-Siamese bullock; of these three Indian bullocks reacted positively.

At Kwala Lumpur, on the 11th November, two Siamese bullocks and one Indian bullock were tested; one Siamese bullock was proved to be affected. This animal (Photograph 3)* was transferred to the Institute on the 21st November; and the usual systematic observations made (Chart II).*

The bullock was aged and when first noted was much emaciated; trypanosomes were first found microscopically on the 3rd December, again after an interval of 35 days, subsequently the parasites were met with more frequently and in greater abundance. In the later stages exacerbations of temperature were seen to coincide with an increase in the number of parasites. Death took place on the 9th March, 1907. Throughout the period of observation the appetite was good, but the general condition of the animal did not improve.

At Port Swettenham, on the 14th November, blood films were examined from over 50 cattle which had just arrived from Kedah, no trypanosomes were found; inoculations were made from three Siamese bullocks and one buffalo, two of the bullocks proved to be affected. It is hoped later on to similarly examine a number of freshly imported Indian cattle.

On December 18th, at Klang, a white Australian gelding (Photograph 2)* was discovered to be suffering from the disease. This animal was stabled near where the second and third equine cases were found.

A tour was made through the State of Selangor and inoculations made from cattle and horses in various districts. No case of trypanosomiasis was thus found; unfortunately, only a limited number of rabbits and guinea-pigs were available.

Cattle infected with trypanosomes may for a long time show no symptoms, and in the early stages at least trypanosomes are extremely scanty, so that a microscopic examination alone is unlikely to reveal the presence of the parasite; in the later stages, when emaciation is pronounced and the animal is obviously ill, trypanosomes are more frequently met with, although not daily; thus there is still a chance that on the day of examination the bodies may not be detected.

In equines the disease runs a more rapid course and symptoms are pronounced, trypanosomes are, as a rule, to be found microscopically.

Experimentally it has been shown that inoculation of the blood from a naturally infected bullock to a healthy horse will produce a disease which runs a course like that met with in naturally infected equines.

* Not reproduced.

A donkey was inoculated from the first horse and parasites were found after five days (Chart 3).^{*} The only clinical symptoms observed were the temperature, anæmia, and emaciation. Death ensued 116 days after inoculation.

A black mare was inoculated from the donkey and parasites were found after four days (Chart 4)^{*}; the usual clinical symptoms were observed; the animal died after 27 days.

A Siamese heifer was inoculated from the black mare and trypanosomes were found after four days. The parasites could not be found after the eleventh day, but they reappeared on the fifty-fifth day, since when microscopic examination has failed to detect the parasite, and up to the present the health and general condition of the animal remains unimpaired.

The length of the trypanosomes met with in horses ranged from $18.5\ \mu$ to $28\ \mu$ and the maximum breadth from $1.5\ \mu$ to $2.5\ \mu$. In bullocks these measurements were from $21\ \mu$ to $27\ \mu$ and $1.5\ \mu$ to $2\ \mu$, in rabbits the dimensions ranged from $16\ \mu$ to $26\ \mu$ and $1.5\ \mu$ to $2\ \mu$, in guinea-pigs the parasites varied in size from $20\ \mu$ to $25\ \mu$, by $1.5\ \mu$ to $2.5\ \mu$, and in rats $21\ \mu$ to $28\ \mu$ by $1.5\ \mu$ to $2.5\ \mu$.

The methods of Leishman and of Giemsa were employed in staining the parasites.

The nucleus, which varied in length 1.5 to $6.5\ \mu$, was situated in the middle of the body; the small rounded blepharoplast was, as a rule, situated from $1.5\ \mu$ to $3.5\ \mu$ distant from the posterior extremity of the parasite. In the protoplasm, especially of the posterior half of the parasite, granules, which stained a reddish violet, were frequently met with.

In any one animal the parasites observed varied considerably in size and structural details which may possibly be accounted for by differences in age or sex of the trypanosomes.

Post-mortem. In bodies kept on ice live trypanosomes have been found 20 hours after death; degeneration of the parasites may be noted shortly before death and soon after becomes very pronounced, the nucleus and the flagellum in these forms is very evident; the protoplasm appears to be melting away, occasionally great clumps of these disintegrating parasites are met with; in one case, a guinea-pig, the chromatin filaments stained very darkly and appeared very thick, a nucleus was frequently seen near the free filament (*vide* Photograph 8).^{*}

In rabbits, inoculated from horses, the parasites were first observed after from 3 to 5 days, and the interval between inoculation and death varied from 8 to 26 days.

In rabbits, inoculated from bullocks, the incubation period was from 7 to 8 days, and death occurred after from 17 to 46 days.

Guinea-pigs, infected from horses, had an incubation period of from 4 to 7 days, and a fatal result ensued in from 15 to 40 days; in similar infection from bullocks the incubation ranged from 6 to 12 days, and a fatal termination occurred in from 30 to 68 days.

Several rats were inoculated from horses and the parasite was first noted after 2 to 3 days, and death took place after from 5 to 8 days.

The liability of rats to be infected with *Trypanosoma Lewisi* rendered their use inadvisable.

We have not observed œdema either in rabbits or in guinea-pigs, as noted by some writers, nor have we found any difficulty in finding trypanosomes with the microscope in these animals; it is true they may not be detected for a few days at a time, but they are certain to return, and in considerable numbers.

At the time of death trypanosomes were usually scanty in horses; in one bullock they swarmed, and in another they were not found; in rabbits they were, as a rule, scanty; in guinea-pigs and rats they swarmed.

No relationship was found to exist between the amount of blood inoculated and the incubation period, but it is noteworthy that in animals inoculated with the blood from cattle, in which the parasites were not found microscopically, a longer

^{*} Not reproduced.

incubation was, as a rule, observed than in animals similarly inoculated from horses.

Whilst it cannot be asserted that the inoculation of rabbits and guinea-pigs from suspected cattle is an absolutely certain method of detecting trypanosomiasis, it undoubtedly possesses a high degree of reliability.

In the case of equines, experimental inoculation will not, as a rule, be necessary, but in the case of suspected cattle it is essential; such a procedure on a large scale would of course be impracticable.

Numerous attempts have been made to cultivate the trypanosomes; various media have been employed and the temperature of incubation has been varied; but in no instance was proliferation of the parasites observed.

Experiments have been made with biting flies. Two species of tabanus have so far been employed, and, as their specific name has not yet been determined, they are provisionally called the "red" and the "grey" tabanus, and very common in these States.

Two grey tabani were fed on a naturally infected bullock and immediately transferred to a black Australian gelding (*vide* Photograph 4); this animal showed trypanosomes in its blood after 9 days. A rabbit inoculated from the horse just after the biting experiment did not develop the parasite.

A grey tabanus was fed on the infected bullock and thereafter on a rabbit which developed trypanosomiasis after seven days.

A red tabanus was fed on the Australian gelding and thereafter on a rabbit in whose blood the parasite was found after eight days.

So far, experiments have only been conducted which show that these flies can transmit the disease mechanically.

It is proposed to further experiment with these as well as other biting flies.

No experiments have so far been made in treatment; no very encouraging results have been obtained by the numerous investigators of the subject, and the large list of remedies which have been tried show that much light remains to be shed on this difficult problem.

The results so far obtained show that:—

- (1) The parasite corresponds with that described as the *Trypanosoma Evansi* which produces surra.
- (2) The trypanosomes found in cattle and horses are closely related, probably identical.
- (3) Trypanosomiasis is endemic.
- (4) Trypanosomiasis is being imported in Siamese cattle.
- (5) Trypanosomiasis is being imported in Indian cattle as was seen in the Batu Gajah outbreak.
- (6) Both the "red" and the "grey" tabanus can transmit the disease mechanically.

No. 6 in Appendix VII.

FEDERATED MALAY STATES.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received December 7, 1907.)

MY LORD,

Government House, Singapore, November 13, 1907.

I HAVE the honour to forward herewith a report on the work done in the Institute for Medical Research at Kuala Lumpur during the six months April to September, 1907.

I have, &c.,
JOHN ANDERSON.

Enclosure in No. 6 in Appendix VII.

SIX-MONTHLY REPORT OF THE INSTITUTE FOR MEDICAL RESEARCH, KUALA LUMPUR,
FEDERATED MALAY STATES.

During the past six months, attention has been mainly directed to the investigation of beri-beri. After the preliminary arrangements had been completed, the work was initiated on the 12th May, and is proceeding in a satisfactory manner.

On the 26th May, 1907, Dr. A. T. Stanton arrived, and is now assisting with this work.

The investigation of trypanosomiasis in conjunction with Mr. S. L. Symonds, Veterinary Surgeon, has been continued.

A considerable amount of routine work has been performed, such as the examination of pathological material, and the conduction of autopsies.

The bacteriologist has been engaged on the routine work of his post.

The chemist has carried out a large amount of work chiefly of a medico-legal nature. A number of samples of morphia (chiefly morphine hydrochloride) have been examined under the Morphine Enactment, which prohibits the sale or possession of this drug by unregistered persons. Opium and chandu, that is opium as prepared for smoking, has necessitated a considerable amount of investigation. Fourteen toxicological analyses were made, and yielded three positive results.

The entomologist has reported on three pests which affect gutta-percha plants, and has devoted a large part of his time to the study of white ants, which are causing some degree of destruction to rubber trees.

* * * * *

Trypanosomiasis.

Numerous experiments have been made with biting flies; in contradistinction to what has been met with elsewhere, the difficulty has been to get the flies to bite, thus as many as 15 or 20 flies would be tried in a day, and not one would feed; on other occasions two or three would be successful. The work has, therefore, proceeded slowly. We have been unable to secure conditions suitable for breeding these insects, and our experiments have been carried out with biting flies caught in or about Kuala Lumpur, and from the Klang District. The experimental animals were invariably kept in fly-proof stalls or cages.

MECHANICAL TRANSMISSION FROM INFECTED TO NON-INFECTED ANIMALS BY MEANS OF
BITING FLIES.I. *Grey species of Tabanus.*

- (a) A fly of this species was fed on an infected horse (Experiment 343). This animal had been affected with surra for 33 days, and parasites were plentiful in the peripheral blood. The fly fed well, and blood flowed freely from the puncture. The insect was transferred immediately thereafter to a horse (Experiment 280), on which, after resting for a few minutes, it proceeded to feed.

The blood of the horse (280) was examined microscopically on 25 successive days with negative results. The temperature continued normal.

- (b) A fly of this species was allowed to feed on a naturally-infected bullock (Experiment 51), which was in an advanced stage of the disease, and in whose blood the parasites were scanty. The insect was immediately transferred to a rabbit (Experiment 350), on which feeding was repeated, but no blood flowed from the several punctures made. Daily examinations of the rabbit's blood were thereafter made, and trypanosomes found on the eighth day; the rabbit died on the fifty-seventh day.
- (c) Two flies of this species were fed on a naturally-infected bullock (Experiment 51) one day previous to the death of that animal; parasites were then plentiful in the peripheral blood. On transference to a horse

(Experiment 280) feeding was repeated after the insects had rested for about five minutes. Trypanosomes were found on the ninth day in the blood of the horse, which died after 77 days, having shown the symptoms characteristic of surra.

- (d) A fly of this species was fed on a naturally-infected bullock (Experiment 51) eight days previous to the death of that animal; parasites could not be found by microscopical examination. The insect was then allowed to feed on a rabbit (Experiment 351) whose blood was examined thereafter for 54 days with negative results.

II. *Red species of Tabanus.* (*Tabanus Fumifer.* Walker).

- (a) A fly of this species was fed on a naturally-infected bullock (Experiment 51) 12 days previous to the death of that animal, and in whose blood parasites were then plentiful. On transferring the fly to a rabbit (Experiment 349) feeding was repeated. Examination of the blood for 54 days was made with negative results.
- (b) Three flies of this species were fed on a horse (Experiment 280), which was in the fifth day of the disease, and in whose blood parasites could not then be found. On transference to a rabbit (Experiment 356) feeding was repeated. Examination of the blood was made for 31 days with negative results.
- (c) A fly of this species was fed on a horse (Experiment 280), when in the tenth day of the disease; parasites were then plentiful. The fly was transferred to a rabbit (Experiment 357) on whom the fly effected several punctures, but did not apparently draw blood. Eight days later trypanosomes were found in the blood of the rabbit, which died in 57 days.
- (d) A fly of this species was fed on a horse (Experiment 280) four days previous to the death of that animal, and in whose blood parasites were then plentiful. Transferred to a bullock (Experiment 373) the feeding was repeated; the blood thereafter was examined for 25 days with negative results. Later, the bullock developed trypanosomiasis as the result of subcutaneous injection with blood from this horse.
- (e) A fly of this species was fed on a naturally-infected bullock (Experiment 376) 10 days previous to the death of that animal and in whose blood parasites could not then be found. The fly was thereafter fed on a rabbit (Experiment 331) whose blood was examined on 25 successive days with negative results.

III. *Small species of Tabanus.*

- (a) A fly of this species was fed on a horse (Experiment 384) which was then in the third day of the disease and in whose blood the parasites were scanty. The fly was thereafter fed on a dog (Experiment 385). Two days later this experiment was repeated. Eight days later a fly of this species was fed on a bullock (Experiment 386) which was in the fourth day of the disease and in whose blood parasites were plentiful. The fly was next fed on a dog. Seven days later trypanosomes were found in the blood of the dog which died on the twelfth day.

IV. *Flies of the genus Stomoxys.*

- (a) A fly of this genus was allowed to feed on a horse (Experiment 280) which was in the twenty-fifth day of the disease and in whose blood trypanosomes were plentiful; it was then fed on rabbit (Experiment 361) whose blood was examined for 25 days with negative results.
- (b) Two flies of this genus were partially fed on a horse (Experiment 280) which was in the thirtieth day of the disease and in whose blood trypanosomes were plentiful; they were then allowed to complete their feeding on a rabbit (Experiment 364). Eleven days later and when the parasites were swarming in the blood of the horse this experiment was repeated with another two flies of this genus. The blood of the rabbit was examined on 15 consecutive days with negative results.

- (c) Eleven flies of this genus were fed on a horse (Experiment 280) which was in the fifty-seventh day of the disease and in whose blood parasites were plentiful; the flies were then fed on another horse (Experiment 366). Examination of this horse's blood was thereafter made for 40 days with negative results.
- (d) Three flies of this genus were fed on a horse (Experiment 280) seven days previous to the death of that animal and in whose blood trypanosomes were scanty. The flies were then fed on a rabbit (Experiment 372). The blood of the rabbit was thereafter examined for 25 days with negative results.
- (e) Eight flies of this genus were fed on a dog (Experiment 436) which was then in the third day of the disease and in whose blood parasites were few. The flies were then fed on a rabbit (Experiment 440). On the same day four flies of this genus were fed on a dog (Experiment 431) which was in the thirtieth day of the disease and in whose blood parasites were plentiful. The flies were next fed on the rabbit whose blood was examined for more than 30 days with negative results.

V. *Flies of the genus Hæmatopota.*

- (a) A fly of this genus was fed on a horse (Experiment 280) which was in the twenty-fifth day of the disease and in whose blood parasites were plentiful; the fly was thereafter fed on a rabbit (Experiment 361) whose blood was examined for 25 days with negative results.
- (b) A fly of this genus fed on a horse (Experiment 384) whose death took place on the following day and in whose blood parasites were plentiful. The fly was then fed on a guinea-pig (Experiment 413) whose blood was examined for 30 days with negative results.

ATTEMPT TO TRANSMIT TRYPANOSOMIASIS BY MEANS OF BITING FLIES WHICH HAD FED ON AN AFFECTED ANIMAL 48 TO 72 HOURS PREVIOUSLY.

It was found extremely difficult to get flies to bite when 48 or 72 hours had elapsed since their previous feed. Nearly 400 flies were tried, only 38 fed on the infected horse; the experiment extended over six weeks.

Five flies of the grey species of tabanus and four flies of the red species fed on a horse (Experiment 280) in whose blood at the time parasites were plentiful. Forty-eight hours later these flies fed on a Javanese pony (Experiment 347).

Two flies of the grey species of tabanus and two flies of the red species fed on a horse (Experiment 280) in whose blood at the time parasites were plentiful. Seventy-two hours later these flies fed on the Javanese pony.

As by neither of these experiments had the pony become affected, flies of the genus tabanus were fed on the horse (Experiment 280) and after 48 hours let loose in the stall occupied by the Java pony. In all 20 flies of the grey species of tabanus and four flies of the red species were so dealt with. It is impossible to say if any of these flies fed on the pony. After five or six days most of the flies were dead. The blood of the Java pony was regularly examined for over two months, but on no occasion were trypanosomes found.

INOCULATION EXPERIMENTS.

On account of the difficulty in getting flies to feed, even when freshly caught, and the still greater difficulty in getting those which had fed to feed again after an interval of 24 hours or more, it was decided to keep the flies which had fed on infected blood for periods ranging from 24 hours to 14 days; when the required interval had elapsed the fly was killed with chloroform, the wings and legs removed; the body was then opened, the entire contents were scraped out, cut up in normal saline solution by means of a fine scissors, and the resulting emulsion was injected into a guinea-pig. In this way it was found possible to include everything save the chitinous covering, and the interval between the death of the fly and the inoculation of its contents into a susceptible animal could be reduced to a few minutes.

Difficulty was experienced in keeping the infected flies alive in captivity, and, although various plans have been tried, only partial success has attended those efforts.

*Inoculation after 24 hours.*I. *Red species of Tabanus* (*Tabanus Fumifer*. Walker).

- (a) A fly of this species was used which had fed on horse (Experiment 280) one day previous to the death of that animal and in whose blood trypanosomes were scanty. A rabbit (Experiment 375) was used for the inoculation, but trypanosomes were not found on daily examination up to the 17th day when death occurred apparently from septicæmia.
- (b) A fly of this species was used which had fed on a naturally-infected bullock (Experiment 51) seven days previous to the death of that animal and in whose blood, by microscopic examination, trypanosomes could not then be found. A guinea-pig (Experiment 382) was used and the inoculation was made subcutaneously. On the fifteenth day parasites were found and death took place on the ninetieth day.
- (c) A fly of this species fed on a horse (Experiment 384) which was in the twelfth day of the disease and in whose blood there were then but few parasites. A guinea-pig (Experiment 389) was used and an intraperitoneal inoculation was made. On the twelfth day trypanosomes were found and death occurred on the sixty-eighth day.
- (d) A fly of this species fed on a horse (Experiment 384) which was in the fourth day of the disease and in whose blood parasites were then few. Intraperitoneal inoculation was made on a guinea-pig (Experiment 393) which died after 16 days without trypanosomes having on any day been found in the blood.
- (e) A fly of this species fed on a naturally-infected pony (Experiment 432) which was then in the twentieth day of the disease and in whose blood trypanosomes were plentiful. Intraperitoneal inoculation was made on a guinea-pig (Experiment 438) which did not develop trypanosomiasis.

II. *Grey species of Tabanus*.

- (a) A fly of this species fed on a horse (Experiment 384) which was then in the forty-fifth day of the disease and in whose blood the parasites were swarming. Intraperitoneal inoculation was made on a guinea-pig (Experiment 408) which has not developed trypanosomiasis.
- (b) A fly of this species was fed on a naturally-infected pony (Experiment 432) which was then in the twenty-fifth day of the disease and in whose blood parasites were then plentiful. Intraperitoneal inoculation was made on a guinea-pig (Experiment 439) which has not developed trypanosomiasis.

*Inoculation after 48 hours.*I. *Red species of Tabanus* (*Tabanus Fumifer*. Walker).

- (a) A fly of this species was fed on a horse (Experiment 384) which was then in the 13th day of the disease and in whose blood parasites were few. Intraperitoneal inoculation was made on a guinea-pig (Experiment 390) which has not developed trypanosomiasis.

II. *Grey species of Tabanus*.

- (a) A fly of this species was fed on a horse (Experiment 384) which was then in the forty-third day of the disease and in whose blood trypanosomes were swarming. Intraperitoneal inoculation was made on a guinea-pig which did not develop trypanosomiasis.

*Inoculation after 72 hours.*I. *Red species of Tabanus* (*Tabanus Fumifer*. Walker).

- (a) A fly of this species was fed on a horse (Experiment 384) which was then in the fifteenth day of the disease and in whose blood trypanosomes

were plentiful. Intraperitoneal inoculation was made on a guinea-pig (Experiment 394) in whom 62 subsequent daily examinations have failed to find trypanosomes.

II. *Grey species of Tabanus.*

- (a) A fly of this species was fed on a naturally-infected pony (Experiment 432) which was then in about the twentieth day of the disease and in whose blood trypanosomes were plentiful. Intraperitoneal inoculation was made on a guinea-pig (Experiment 437) which has not developed trypanosomiasis.

Inoculation after 96 hours.

I. *Red species of Tabanus* (Tabanus Fumifer. Walker).

- (a) A fly of this species was fed on a horse (Experiment 384) which was in the sixteenth day of the disease and in whose blood trypanosomes were plentiful. Intraperitoneal inoculation was made on a guinea-pig (Experiment 396) in whom 60 subsequent daily examinations have failed to find trypanosomes.

Inoculation after 120 hours.

I. *Red species of Tabanus* (Tabanus Fumifer. Walker).

- (a) A fly of this species was fed on a horse (Experiment 384) which was then in the twentieth day of the disease and in whose blood trypanosomes were plentiful. Intraperitoneal inoculation was made on a guinea-pig (Experiment 401) in whom 69 subsequent daily examinations have failed to find trypanosomes.

Inoculation after 7 days.

I. *Grey species of Tabanus.*

- (a) A fly of this species was fed on a naturally-infected pony (Experiment 432) which was then in about the twenty-fifth day of the disease and in whose blood trypanosomes were plentiful. Intraperitoneal inoculation was made on a guinea-pig which has not developed trypanosomiasis.

Inoculation after 10 days.

I. *Red species of Tabanus* (Tabanus Fumifer. Walker).

- (a) A fly of this species was fed on a dog (Experiment 431) which was in the thirty-first day of the disease and in whose blood trypanosomes were then plentiful. Intraperitoneal inoculation was made on a guinea-pig which has not developed trypanosomiasis.

These experiments are proceeding and it is intended to examine a number of flies with a view to determining the presence of flagellates in them.

In the course of this work a leucocytozoon was found in a considerable number of the guinea-pigs; we propose to call the parasite *Leucocytozoon caviae*.

Experiments on the treatment of infected horses are being conducted; so far the most favourable results have been obtained from the use of atoxyl and mercuric chloride.

H. FRASER, Director,
Institute for Medical Research,
Federated Malay States.

Kuala Lumpur,
October 15, 1907.

No. 7 in Appendix VII.

HONG KONG.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received May 15, 1907.)

MY LORD,

Government House, Hong Kong, April 15, 1907.

I HAVE the honour to forward a report by Dr. William Hunter, the Government Bacteriologist, on the investigations made by him during the past six months, prefaced by a short description of the buildings under his charge, and of the scope of the work undertaken in his Department.

I have, &c.,

M. NATHAN,

Governor, &c.

Enclosure in No. 7 in Appendix VII.

SIR,

Bacteriological Institute, Hong Kong, April 12, 1907.

I HAVE the honour to forward my report of research work done in the Bacteriological Institute, for transmission to the Secretary of State for the Colonies, in accordance with No. 197 of 1907.

I have, &c.,

WILLIAM HUNTER.

The Honourable

The Principal Civil Medical Officer,
&c., &c., &c.

REPORT OF THE GOVERNMENT BACTERIOLOGIST, HONG KONG, OCTOBER, 1906, TO
MARCH, 1907.

STAFF.

This consists of the Bacteriologist, Dr. William Hunter, and the Assistant Bacteriologist, Dr. C. M. Heanley.

BUILDINGS.

These consist of the Bacteriological Institute and the Public Mortuary.

The Bacteriological Institute.

This building was completed in the early part of the year 1906. It occupies a site, 20,776 square feet in extent, and consists of a main block and two subsidiary blocks. The main block contains a basement, a ground floor, and an upper floor, and affords the following accommodation:—Four laboratories, each 28 feet by 18 feet; a Director's office and library; a combined waiting room and office; a photographic room and a spare room; store rooms; an incubating room; a refrigerating room, and several small rooms, lavatories, &c.

The general laboratories are of the most modern type, as will be seen from the accompanying photographs. The floors are constructed of cement concrete and covered with encaustic tiles. The walls are lined for a height of six feet with white glazed tiles. All the windows of the laboratories are placed in the north front, and are fixed with plate glass. At either end of the laboratories are double doors, one door being glazed, and the other filled in with mosquito-proof wire gauze. The interior fittings consist of long benches by the wall, and large tables in the centre with teak tops for microscopical work; there are also separate incubators, and shelves

and cupboards for chemicals, media, &c. The laboratories are fitted with sinks, and the hot and cold water taps are of the most modern pattern. A fume cupboard is provided in one of the rooms. A small attached room is used for cleaning apparatus. These two laboratories are used by the Bacteriologist and his Assistant, and in them is carried out all routine bacteriological examinations and research work.

On the upper floor are placed the culture medium and sterilising laboratory and the serum laboratory. They are similar in construction to those on the ground floor, and are fitted with long side and centre benches, &c.

The sterilising laboratory is provided with autoclaves, steaming apparatus, thermostats, and other vessels for the preparation of all kinds of culture media.

The serum laboratory is reserved entirely for the preparation of vaccine lymph and different sera.

The basement of the building contains spacious store rooms, and the incubating room. The latter has double walls lined with asbestos, and the temperature of the room is maintained at the body heat by means of a gas stove, controlled by a Roux's regulator.

The photographic room is fitted with a large Zeiss micro-photographic apparatus, and the windows are fitted with ruby glass. Total darkness can be produced by means of heavy shutters on the outside.

The whole building is fitted with electric light and gas, and with hot and cold water. The two subsidiary blocks afford accommodation for animals and servants' quarters.

The accommodation for animals is provided for by a two-storied building which contains stalls for horses, cattle, and calves, and sheep pens. There are individual enclosures for monkeys, fowls, rats and mice, guinea pigs, rabbits, &c. There is also a room for animals which are under observation, and a room for the preservation of viri immediately before its inoculation.

A corn and fodder store is attached.

An incinerator is provided for destroying the carcasses of the animals used in connection with bacteriological experiments.

Proper provision is made for the Chinese attendants.

The Public Mortuary.

The Public Mortuary was rebuilt on the most modern principles during the year 1904. It is equipped so that the most varied pathological research can be undertaken. The compound includes two large mortuaries, one research laboratory for the examination of rats and other animals, two small laboratories for research microscopic work, and servants' quarters. The photograph attached gives a fair idea of the arrangement of the buildings. The two mortuaries and research room for animals are large and well ventilated. The floors are of concrete, so sloped and grooved that all excrementitious fluid matter passes at once into deep side channels. The walls are white tiled for six feet from the floor and all corners are rounded. The windows, doors, and ventilating flues are fitted with mosquito-proof wire gauze. Water and gas are supplied to each room. The *post-mortem* tables are of slate, and so constructed that they can be readily cleansed. Each mortuary will accommodate 16 bodies. In the animal research room, special accommodation is made for the routine daily examination of rats for the presence or absence of plague. A photograph is attached of the interior of one of the mortuaries.

A small crematorium is attached for the incineration of all dead rats brought for examination.

The whole compound is concreted and rendered with cement. It is thoroughly cleansed daily. The attached photograph shows that the buildings are well isolated from the main part of the city.

GENERAL STATISTICS.

Scope of Routine Work.

The duties of the Bacteriologist and the Assistant Bacteriologist are divided between the Bacteriological Institute and the Public Mortuary.

In the *Bacteriological Institute* all routine pathological and bacteriological examinations are carried out, namely, the monthly examinations of the public water supplies, the preparation of calf lymph for vaccination, the examination of the efficacy of different chemical disinfectants, and the examination of a variety of

clinical material, *e.g.*, Widal tests for typhoid, paratyphoid, dysentery, &c.; swabs for diphtheria, sputa, pathological fluids, tumours, &c.

In the *Public Mortuary*, on an average, about 2,000 autopsies have to be made annually. In addition to this 30,000 to 50,000 rats are examined bacteriologically for the presence or absence of plague infection. A considerable amount of medico-legal work is also entailed, as many of the *post-mortem* examinations are held upon bodies of individuals brought for the determination of the cause of death by the police authorities, and this frequently necessitates subsequent attendance at coroner's inquests and the assizes.

Scope of General Research Work.

Research and experimental work is regularly done, especially with reference to plague, rinderpest, hæmorrhagic septicæmia, beriberi, and other local diseases.

During the past six months our research work has been attempted along the following lines:—

1. The hæmatozoa [malaria excepted] prevalent in Hong Kong, with a partial study of their life-histories.
2. The varieties of rats and fleas in Hong Kong, with special reference to their conveyance of plague infection.
3. The investigation of cattle disease, with special reference to its nature, mode of propagation, prevention, and cure.
4. The varieties of dysentery in Hong Kong, and the isolation of types of the *B. dysenteriae*.
5. The investigation of cases, met with during ordinary routine work, and deserving of special study from a pathological and bacteriological standpoint.

Trypanosomiasis of Frogs.

Trypanosomata have been found in different species of frogs in many countries. Up to the year 1904, only one variety appears to have been described, namely, that originally called by Mayer in 1843 the *Trypanosoma rotatorium*. In 1904, other four varieties were described by Dutton and Todd, Sargent and Laveran. Much diversity of opinion exists, however, as to the exact differences in species shown by these forms, and the subject is deserving of much fuller attention on the part of tropical protozoologists. In this part of the world practically nothing is known as regards these parasites, and the recent report of Musgrave and Clegg shows that repeated search has failed to find trypanosomata in the blood of any of the frogs examined in the Philippine Islands.

A large number of frogs has been examined recently in Hong Kong, and in addition to the more or less constant presence of drepanidia and dactylosoma in the edible frog [*Rana esculenta*], many of these showed a triple infection, namely, with trypanosomata. These trypanosomata have as yet been found in the edible frog only. In the rock frog, or non-edible variety, they would appear, like dactylosoma, not to be present.

The following is a short description of the form found in Hong Kong and neighbourhood.

Animal.—Edible frog, *Rana esculenta*.

Distribution.—The Colony of Hong Kong, Canton, and neighbouring country.

Size.—This varies greatly.

Length, 10 to 50 u. or longer.

Breadth, 2 to 25 u.

It may be practically circular.

Length of flagellum, 5 to 10 u. The flagellum may be absent.

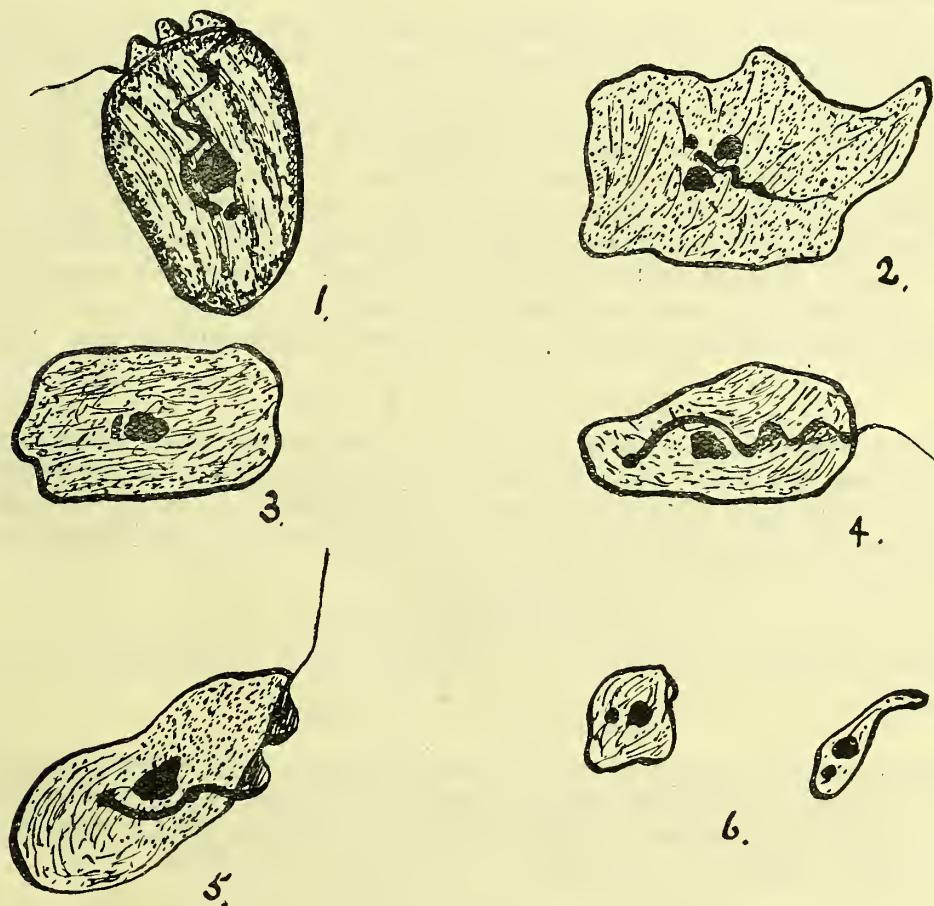
Shape and Structure.—This trypanosome is pleomorphous. It varies much in shape and outline. The majority are rounded, oval, or pear-shaped, but smaller varieties are also seen, which correspond with those recently described by Bouet in the "Annales de L'Institut Pasteur," Tome XX. In general, the main types of the parasite are in harmony with the account given by Laveran and Mesnil in their book on trypanosomiasis, published in Paris in 1904.

The trypanosome may move in one of two ways, either flagellar or amoeboid. It is easily stained by Giemsa's fluid or any of the modifications of Romanowsky's

method. Most forms possess a very granular protoplasm, which may be general or confined to certain areas of the body, resembling some of the varieties described by Dutton in Africa. A striking feature of the parasite, not infrequently seen, is the appearance as if the body was composed of packets or bundles of protoplasm. In some forms this appearance may be only slightly marked or entirely absent. This is seen in forms which show practically no sign of a flagellum or undulating membrane. The nucleus is oval and usually situated near the centre of the body. Sometimes the nucleus is found to have split into two parts. In such cases the blepharoblast is found in close proximity, and the packet-shaped appearance of the protoplasm is either faintly seen or entirely absent. Actual multiplication of the trypanosome has not been seen, but the foregoing suggests preparation for fission. The blepharoblast, in full-sized forms, is situated at a short distance from the nucleus, sometimes midway between the latter and the posterior end. In smaller forms and in those already mentioned, the centrosome lies close to the nucleus. The undulating membrane varies in its development. In full-sized forms it is broad and long, but in others it may be represented by a short cilium only. Again, it may be absent. It has been found impossible to infect other frogs with these parasites.

Owing to the great variety in form of these parasites and their agreement in several particulars with the forms described by Dutton and others, it appears highly probable that the interpretation of Laveran and Mesnil is correct, namely, that the various frog trypanosomata described are merely varieties or phases in the life history of one form, *i.e.*, the *Trypanosoma rotatorium* (Mayer).

Further, it is interesting to bear in mind that these trypanosomata of frogs have never been found alone. They would appear to be always associated with some form of hæmogregarine. Bearing Schaudinn's results with hæmoproteus in mind, is there any possibility of some close connection between these various hæmatozoic forms found in the frog?



Trypanosoma rotatorium.

Different forms found in the blood and internal organs of the frog—*Rana esculenta* :—

1. Common type, with striped protoplasm.
2. Probably developmental form, with granular protoplasm.
3. Probably developmental or resting form with granular protoplasm.
4. Similar to No. 1, protoplasm not striped.
5. Similar to African frog trypanosomata.
6. Young forms, these resemble some large free forms of *Dactylosoma*.

Trypanosomata of Fish.

These are extremely common parasites in fish caught in the neighbourhood of Hong Kong. So far my examination of a large number of fish has resulted in showing the presence of trypanosomes in eels, barbel, bream, carp, fresh water salmon, tench, and sole.

In the majority of cases, the parasites are present in very limited numbers, requiring a prolonged search through each film in order to come across an example. The best method of determining their presence or absence is the use of a wet-film preparation or the examination of a thick, well-stained blood-smear (method of Ross) with a magnification of about 200, fish trypanosomata being usually large in size.

(1) *In Eels*.—Trypanosomata are found in almost every common yellow eel (*Anguilla vulgaris* (?)). In fresh-water eels—so-called—no parasites have been discovered. The parasite varies in size, up to 70-80 u. in length, its breadth rarely exceeding 5 u. Its movements are very active, and it possesses a long flagellum and broad undulating membrane. The centrosome is situated near the pointed posterior extremity. Characteristic is the densely granular nature of the protoplasm, agreeing with the *Trypanosoma granulosum*. Developmental forms have not yet been seen or studied.

(2) *In the Barbel*.—The parasite resembles that found in the eel. Its protoplasm is granular and its movements are active.

(3) *In the Bream*.—The trypanosomata found resemble those noted by Laveran and Mesnil. It is like that found in the barbel.

(4) *In the Carp*.—A few parasites have been found in several of the specimens examined. They are at least 40 u. long with finely granular protoplasm, and show very active movements.

(5) *In the Salmon*.—Next to the eel, the salmon show more or less regularly the presence of trypanosomata. They resemble those described in the foregoing.

(6) *In the Tench*.—Ditto. Only a few examples have been examined.

(7) *In the Sole*.—The parasite is at least 30-40 u. long, very active, and possesses a well developed undulating membrane and cilium. Its protoplasm is also granular. With the limited time at our disposal it has been impossible to give more than this passing reference to the incidence of these parasites. It is hoped that by further study the number of these will be increased, and also more details can be obtained regarding their minute structure, development and life history.

The association of fish trypanosomata with hæmogregarines has, so far, not been noted.

Trypanosomata in Reptiles.

Several examples have been examined with negative results. My examinations have been limited in number, and, as Laveran and Mesnil describe the *Trypanosoma damoniae* as occurring in China and Japan, it is desirable to continue the search for these parasites. It may be noted that hæmogregarines have been found in certain varieties of snakes caught in the Colony.

Trypanosomata in Birds.

Up to the present no parasites have been found in any bird caught and examined in the Colony.

Trypanosomata in Mammals.

Trypanosoma Lewisi is frequently found in rats found in the Colony.

The incidence of trypanosomata in oxen and horses in Hong Kong has been dealt with in a special communication, by Mr. A. Gibson, the Colonial Veterinary Surgeon, to the "Journal of Comparative Pathology" for 1906.

THE HÆMOPROTEUS OF BIRDS IN HONG KONG.

The question of hæmoproteus and trypanosoma infection of birds has, within the past year or two, come prominently into the foreground, as a subject of considerable interest—the result of the important researches of the late Dr. Schaudinn. Up to the publication by Schaudinn of his observations, the halteridia parasitic in the red blood corpuscles, and the trypanosomata found in the circulation, of birds, were held to be entirely distinct hæmatozoa.

Schaudinn, however, believes that he has demonstrated that both forms are but stages in the life history of one parasite, the hæmoproteus.

These results have been completely confirmed by E. and Et. Sergent. On the other hand they have been entirely negatived by the investigations of Novy and McNeal. One of the chief points of objection raised to the observations of Schaudinn is that he was dealing with a double infection. This, however, would appear extremely unlikely after careful consideration of his results, although nearly a dozen different avian trypanosomata have been described. Therefore, as little time has yet elapsed in order to prove or disprove these important observations, it appeared, in the presence of a wealth of material at hand in Hong Kong, that something either positive or negative might be added to the question which is as yet the subject of considerable doubt in most tropical medical circles.

The halteridium is the commonest blood parasite of birds in Hong Kong. It is found in a large number of species, especially in pigeons, doves, sparrows, and paddy birds. The infection is, in most cases, very pronounced, and our experience is in agreement with the statement of R. Koch, that tropical pigeons and doves are almost always grossly infected with the parasite.

General Characteristics of the Halteridium.

The Sexual Forms.—These are of the well known shape. There is no displacement of the nucleus of the infected corpuscle. The parasites produce a marked degeneration of the red blood corpuscles. The macro- and micro-gametocytes are distinct, and show the usual differences in appearance when stained. The nucleus, which is largest in the male gamete, stains well, and lying close to it is found a deeply stained chromatin dot, which corresponds to that described by Schaudinn, and is in all probability the blepharoblast. This is well seen in specimens which to begin with have been well stained and then partially faded. In such preparations this deep red spot is found lying close up against the faintly red nucleus. The pigment granules are coarser than those found in proteosoma. These are practically all the changes which can be made out in a well prepared and rapidly dried blood film. Should, however, the blood be kept moist for one or two minutes as in a wet film preparation, other changes can be seen, especially the formation of micro-gametes, vermiculi, &c.

The formation of four to six micro-gametes occurs in the usual manner leaving behind the remainder of the gamete which degenerates. The nucleus divides into four or six daughter nuclei, each with a deep red spot on their outer edge.

The exact formation of the micro-gamete and its structure is difficult to follow, and so far it has been impossible to make out the details described by Schaudinn.

The changes which occur in the female gamete and the vermiculi have not as yet been studied.

Further, it is interesting to note that the halteridium found in the blood of pigeons in Hong Kong resembles the *Hæmamaeba Metchnikowi* found in the blood of a large water tortoise in many Indian rivers. Not only are male and female gametes to be found in different corpuscles, but, as Simond has pointed out, a male and female gamete is often found in the same red cell—*vide* figure 7 on the attached diagram. This, so far as I know, has never before been observed in the case of the ordinary *H. Danilewskyi*. Further unpigmented as well as pigmented forms are met with, *e.g.*, in young forms of the parasite.

The various types of the several forms of the halteridium are roughly sketched on figure No. 1.

The Non-Sexual Forms.—What appear to be non-sexual forms have also occasionally been seen in the peripheral blood of a number of the doves examined. They are few in number, being most commonly met with in blood films prepared during the evening. If doves showing these forms in the peripheral blood be killed, and their internal organs examined, more numerous examples of these peculiar forms of the parasite will be found, especially in the spleen and bone-marrow. The accompanying rough sketches (figure No. 2) are examples of the forms which have been found during the systematic examination of a number of doves. They show a marked likeness to the parasites figured by Dr. Schaudinn in his article on trypanosomata, &c., in the "Arbeiten aus d. Kaiserl. Gesundheitsamte," 1904. Undoubtedly they resemble certain forms met with in the life history of trypanosomata, and are strong evidence in favour of Schaudinn's work on hæmoproteus.

Unfortunately they are so few in numbers, and apparently only present in the

blood of pigeons during certain definite periods of the infection. My own experience points to their presence only during the early stages of the infection.

An extended series of observations was made upon two pigeons whose blood showed the presence of halteridia in considerable numbers. The pigeons were kept in mosquito-proof baskets. Blood films were made daily from each, and frequently the morning and evening condition of the blood was examined. These observations extended for upwards of 50 days, and were carried out in order to definitely determine what changes, if any, occur during the growth of the parasite in birds, otherwise apparently healthy.

The blood films were prepared from blood obtained from the toes of the birds, and in all cases were coloured with Giemsa's solution for the Romanowsky's method of staining.

The following is a *résumé* of the notes made at the time of the examination, the blood content of the animal being daily recorded. As the daily blood condition of both birds more or less exactly coincides, the detail for one animal only is herewith recorded.

No. of Day.

1. Typical gametes; male and female present, young forms also present in considerable numbers. Non-sexual forms found—*vide* Figs. 1 and 2.
2. Ditto, but younger forms more numerous. Single, double, and triple infection of red cells found frequently.
3. Ditto, many of small forms free in plasma; pigment found in many of these.
4. Small forms less numerous; medium sized parasites present in great numbers.
- 5 and 6. Gradually the small forms are disappearing.
7. No small forms found.
8. Ditto; the only forms present are male and female gametes of full size and practically all intracellular.
9. Ditto; examples of male and female gametes in one red cell—*vide* figure 1, No. 7. Forms similar to No. 4 of figure 1 also found free in the plasma.
10. Similar to ninth day, only the halter bodies are fewer in number.
11. Ditto.
12. Ditto. During the evening of this day forms were found like those in figure No. 2, form 1.
13. Ditto. Still no young forms.
14. Ditto. Forms as drawn on figure 2, No. 4, found. Further forms like No. 6 on figure 1 present. These are evidently male gametes; they are clear and hyaline, the pigment is collected at either end of the halter, and what appear to be daughter nuclei are also polar.
15. Adult male and female gametes present only, but apparently fewer in number. In many of the male forms, a pale blue and sharply circumscribed blue spot is found either central or at one end. Its significance is not clear. Forms similar to No. 3 of figure 2 also present.
16. Number of male and female gametes about equal, still diminishing in number; no young forms found.
17. Ditto. Blue spot still found present in many of the micro-gametocytes.
18. Similar to 17th day.
19. Ditto.
20. Ditto.
21. Ditto.
22. The number of gametes has now greatly diminished, only about half a dozen being found in a blood film.
23. Ditto.
24. Ditto, but male gametes predominate in numbers.
25. Ditto.
26. Ditto.
27. Ditto.
28. Ditto.
29. Very few parasites present; no female gametes found; no young forms.
30. A few young forms have appeared. The adult forms are few in number. The male gametes are present in largest numbers, and a few show the blue body situated centrally and undergoing division into two. This body now stains very deeply bluish-black.

No. of Day.

30 p.m. Young parasites much more numerous.

31. The condition of blood films made to-day is similar to that of the second, third and fourth days. Many young male and female forms are seen, some of which are very minute and contain no pigment. The majority are intracellular, but forms free in the plasma are also found. A few adult forms are also present, particularly male gametes, and in these the blue spot is frequently present, generally central with a deep purple halo around it. The amount of chromatin in the adult forms, especially that of the females, is much increased, and in some cases scattered throughout the body of the parasite. The condition suggests a rejuvenescence of the parasite.
32. Young forms are still present in large numbers, resembling those drawn on figure 1, No. 1, and figure 2, No. 5. No pigment is to be found in these, but they are rich in chromatin. Several of the young parasites may be found in one cell. The adult females are now increased in number.
33. Young forms still present in considerable numbers; adult forms are also present.
34. Ditto.
35. Many half-sized male and female gametes present. No free forms seen. No blue body is to be found in any of the male gametes. Full-sized gametes are very few in number.
36. Ditto.
37. Ditto.
38. No very small forms found. The condition otherwise is similar to day No. 35.
39. Young forms appear to have gone. A considerable number of adult males and females found, the former showing an occasional blue body.
40. No young forms found.
41. Ditto. Adult male and female gametes present and intracellular. A very pronounced eosinophilia is present.
42. Ditto.
43. Ditto.
44. Ditto. Blue body present in many of the males.
45. Ditto.
46. Ditto.
47. Ditto.
48. Ditto.
49. Ditto.
50. Ditto. The adult male and female gametes are large, almost bursting the red corpuscle. Blue spot present in males with a halo around it.
51. Ditto.
52. Ditto.
53. Ditto.
54. Ditto.
55. Ditto.
56. Ditto.
57. Ditto. The parasites have gradually become very few in numbers. No young forms.
58. Ditto. Male gametes show the blue body with a deep purple halo. A few young parasites are seen—these are minute rings with chromatin.
59. Ditto.
60. The young forms are present in considerable numbers. Only one or two adult parasites found present.
61. Ditto.
62. Ditto.
63. Ditto.
64. The young parasites resemble those already described on the 31st and 32nd day. Adult forms are rare.
65. Ditto. An occasional half-grown form is found.
66. The youngest forms are disappearing. Many half-grown forms are present, and a differentiation into male and female gametes is possible. Two males, or two females, or a male and a female gamete, have been found in a single red cell.
67. Ditto.

No. of Day.

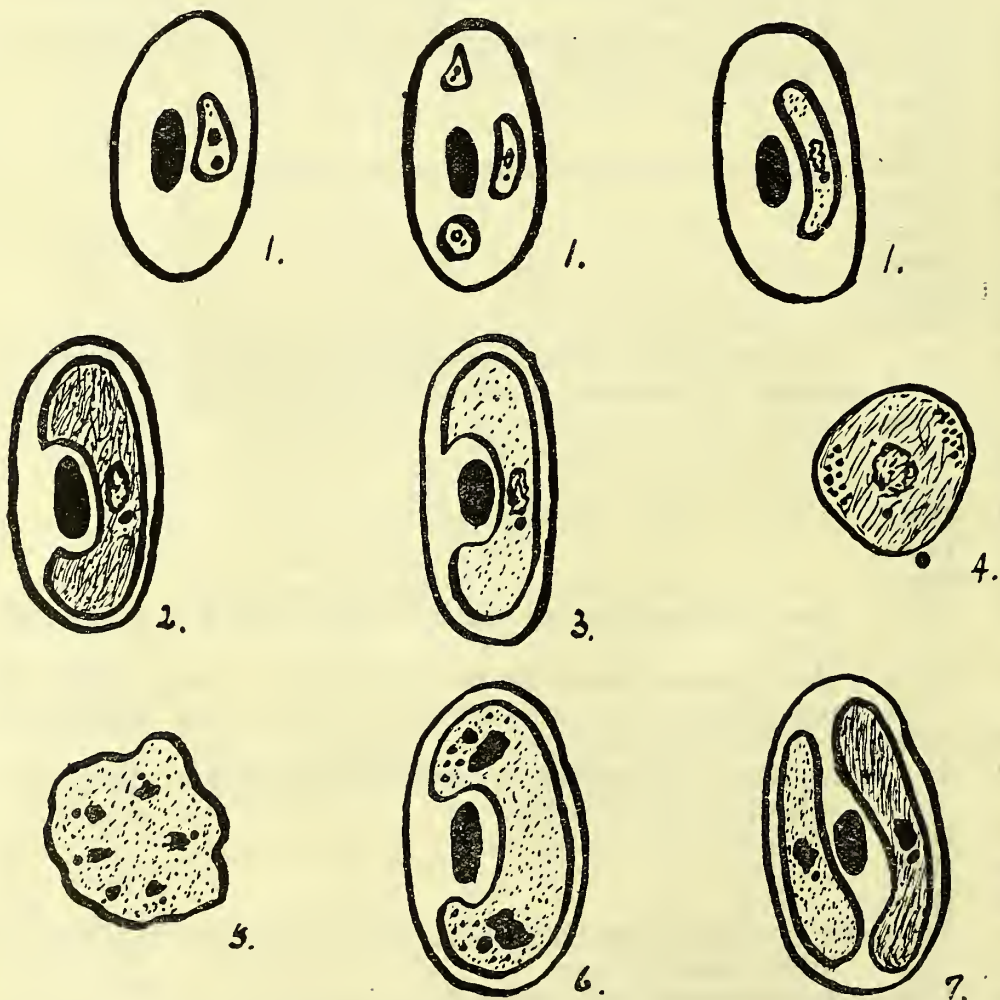
68. The young forms have gone. Half-sized and adult male and female gametes are present. The condition is now similar to that found on the 40th and 41st day.

Observations ceased after this date.

The foregoing *résumé* shows that the parasite undergoes a regular cycle of changes within the blood of the bird. This cycle, so far as I can make out, is a long one, lasting on an average 30 days. After this interval the parasite would appear to break up by schizogony, and renew the cycle. These results are somewhat in favour of the observations of Labbé (Labbé-Sporozoa, 1899), although actual division has not been seen.

In the majority of cases, the young forms met with would not appear to resemble the non-sexual trypanosoma-like bodies described by Schaudinn. I have failed to find in most of these minute parasites any trace of a cilium or membrane proceeding from the red chromatin spot which is present in most of them. However, occasionally—*vide résumé*—forms like those figured by Schaudinn are seen, but they are always exceedingly few in number, at least in the peripheral blood. I have not yet had the opportunity of examining the internal organs of a dove at the stage of schizogony or at the period when the young forms are present in greatest profusion, but it appears highly probable that these forms are not the common young types met with while the parasite is in the blood of the bird, and that they really belong to some other stage in the life history of the parasite, *e.g.*, its development in the body of the mosquito. My observations, up to the present, have been confined to the blood of the pigeon and dove, but it is proposed, at the earliest opportunity, to further investigate the parasite and its existence and development in the mosquito.

Figure No. 1.

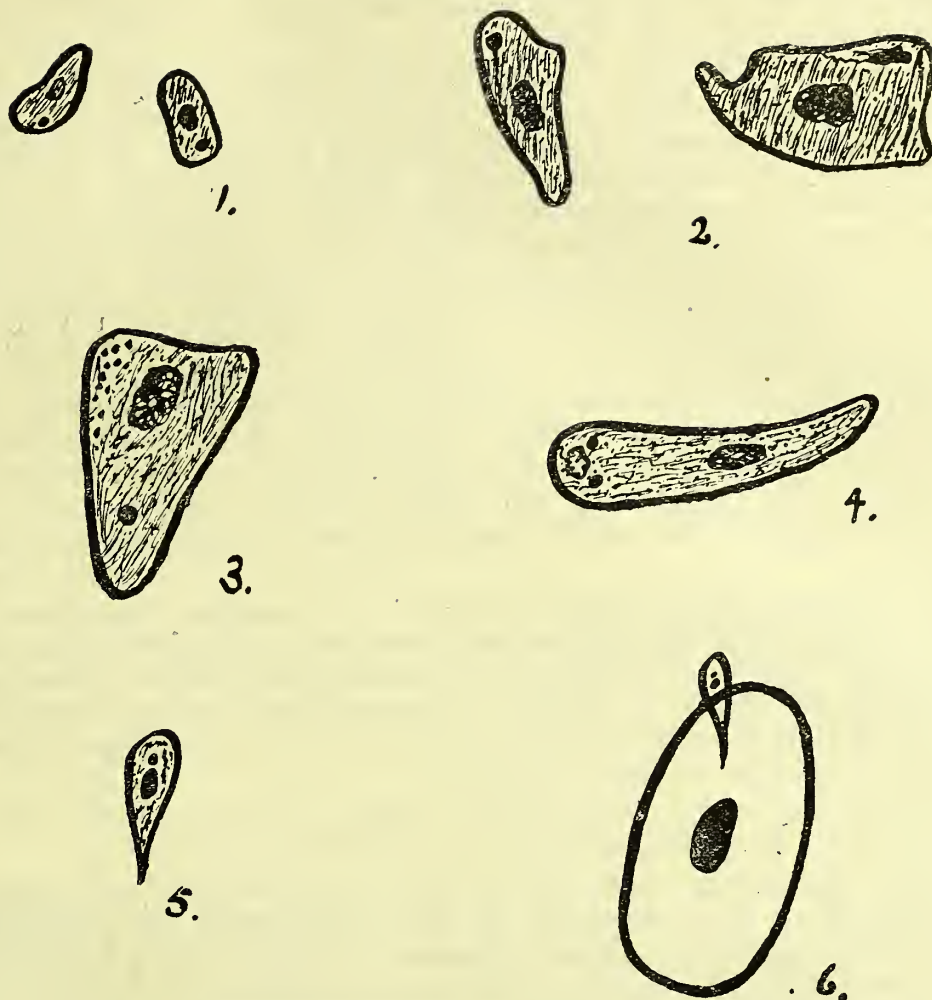


Types of *Halteridium*—Blood of Dove.

1. Young forms.
2. Macrogametocyte.
3. Microgametocyte.
4. Free form.

5. Segmenting male form.
6. Male form with division of nucleus—daughter-nuclei are polar with pigment.
7. Male and female gametes in one corpuscle.

Figure No. 2.

*Types of Halteridium—Blood of Dove.—Non-Sexual Forms.*

1. Young free forms.
2. Free trypanosoma-like bodies.
3. Ditto, with collection of pigment granules.
4. Ditto, with two centrosome-like bodies situated just in front of a deeply blue-staining body.
5. A young free form just before its entrance into a corpuscle.
6. Ditto, entering a corpuscle.

SPIROCHÆTÆ IN HONG KONG.

The following forms have been found :—

1. *Spirochæta Vincenti*.—This form is occasionally met with in cases of noma and facial gangrene. It is always associated with the spindle-shaped bacilli, *Bacillus hastilis* (Seitz), which are supposed to be closely related. Cultural and experimental work is at present being carried out in the laboratory in regard to this question. It seems extremely doubtful that there is any connection between the two forms.

2. *Spirochæta refringens*.—This is often associated with the *Treponema pallidum* in cases of syphilis. I have found it common in balanitis.

3. *Spirochætæ in tropical ulcers*.—These are common and resemble the *Treponema pallidum*.

4. *Spirochætæ in the intestines of children* who have succumbed to diarrhœa have been demonstrated in a number of cases. They resemble the forms described by Le Dantée as occurring in cases of dysentery. At present, we find it impossible to determine their true significance as causal agents.

5. *Spirochæta recurrentis* of relapsing fever is met with occasionally in Hong Kong, but in imported cases only from Northern China.

6. *Spirochætæ in cattle*.—In the Journal of Comparative Pathology and Therapeutics for March, 1904, Dr. A. Theiler describes a disease—spirillosis of cattle—met with in South Africa, and discusses its association with other diseases.

In connection with the subject the following may be of interest, more especially because, so far as we know, spirochætæ have not hitherto been found in the blood of buffaloes or in cattle outside Africa.

On the 2nd October, 1906, two buffalo calves were obtained from the same source for vaccination purposes. They were unusually fine and well-nourished animals. They were quite well on the 6th, but when seen on the 8th their condition was as follows:—The animals had a listless, hanging appearance. They had lost flesh. The flanks were sunken and the backs arched. The head was carried low. There was a muco-purulent discharge from the eyes and nostrils, the muzzle being dry and hard. There was thin, watery, foul-smelling diarrhoea, accompanied by a good deal of straining, but no blood or mucus was noticeable. The animals drank freely, but were taking little food. The temperature per rectum was in one animal 103° F. and in the other 101·5° F. The breathing was regular. On examination an enlarged prescapular lymphatic gland could be felt in both animals. The pre-crural lymphatic glands appeared normal. The papillæ of part of the buccal mucous membrane of one of the calves were distinctly reddened as if by a recent irritant.

The disease was regarded by Mr. Adam Gibson, the Colonial Veterinary Surgeon, who conducted the examination, as either hæmorrhagic septicæmia or rinderpest.

Blood was taken from the ear of one of the animals. No bipolar micro-organisms could be found. No piroplasmata were present, but after fifteen minutes' search, one of us—Dr. C. M. Heanley, the Assistant Bacteriologist—found a single and well-defined spirochæta. They were extremely scanty, as it took myself half an hour to find another example. They were found much more easily in a thick blood film de hæmoglobinized (Ross's method).

The animals died on the following day within two hours of each other. The Colonial Veterinary Surgeon performed the *post-mortem* examinations.

The lesions present left the diagnosis between rinderpest and hæmorrhagic septicæmia doubtful. The prescapular glands were enlarged and hæmorrhagic.

The fourth stomach was intensely congested. There were ulcers and blood-stained mucus in the small intestine. The mucous membrane of the large intestine and rectum had a longitudinally striated appearance, due to the intensely congested condition along the tops of the rugæ. The spleens were normal in appearance. The liver and gall-bladder showed the presence of fine hæmorrhages. The latter were also found in the lungs, pericardium, and the epicardium.

No bipolar organisms could be found in the blood or affected lymphatic glands. The spirochætæ were demonstrated without difficulty in the blood and organs of both animals *post-mortem*. They resembled those described by Theiler in having tapering ends and readily taking aniline dyes. The short atypical forms figured by Theiler were not found. Especially noticeable were forms showing a regular spiral with straight axis, having one end about 16 microns distant from the other, and forms about double this length with bent axis and irregular forms which suggests forms of multiplication. The majority of the spirochætæ show between eight and twelve half-turns.

7. *Spirochæta anserina* of geese and ducks and *S. gallinarum* have not so far been found, although a very considerable number of these animals have been examined.

TROPICAL SPLENOMEGALY IN HONG KONG.

Cases are met with in the Public Mortuary in Hong Kong characterised by the presence of enormous spleens—some 4·5 pounds in weight—great emaciation, and an absence of malarial parasites. Gastro-intestinal lesions are frequently present and often dysentery. It is difficult in these cases to find a true cause of death. Since the publications of Leishman and Donovan, a careful search has been made for the presence of the peculiar parasites described by them, but absolutely without success.

Leishman's bodies would not appear to be present in Hong Kong and the neighbouring parts of China, although cases showing their presence have been described as occurring in Northern China. Up to the present our observations in Hong Kong are in accord with those of Woolley in Manila, detailed in a recent paper in the Philippine Journal of Science [Vol. I., No. 5, p. 533].

PYROPLASMOSIS IN HONG KONG.

Pyroplasmata have frequently been found in cattle and dogs.

In cattle, they may be present in the blood, yet give rise to no symptoms. The parasites have been recognised occasionally in the blood corpuscles of buffalo calves brought to the Bacteriological Institute for the preparation of calf lymph. My experience in this respect is similar to that recently described by Miyajima and Shibayama in the *Zeitschrift für Hygiene*, Bd. 54, 1906. Spontaneous outbreaks of "red-water" also occur from time to time amongst our local herds. Further the disease is frequently set up in European and American cattle by inoculations of "virulent blood" used in the treatment of rinderpest.

The illness, as met with in Hong Kong, has so far not been of a fatal nature, but it leads to profound emaciation.

The rod-shaped forms of the parasite are the commonest types met with in the blood of oxen, otherwise apparently healthy. Not more than one or two parasites are found in each red cell, and they are difficult to stain. This result is specially interesting, as Koch originally described these bacillary forms in the blood of oxen in East Africa, suffering from a rapidly fatal form of the disease.

The pear-shaped forms are also found. They have been observed in the blood of animals suffering from rinderpest.

With the limited time at my disposal, I have as yet been unable to go into the question more thoroughly. Doubtless the name pyroplasmosis includes a series of diseases, and that the pyroplasmata found in different parts of the world belong to a genus with a number of definite species. My examinations are being continued.

Dogs in Hong Kong also occasionally suffer from the disease. It is usually chronic in course.

HÆMOGREGARINES OF AMPHIBIA.

These are extremely common in frogs caught in Hong Kong. *Dactylosoma* is especially frequent in the edible frog (*R. esculenta*), and may be associated with *drepanidium*. In the rock frog, non-edible variety, the *drepanidium* is frequently found. *Dactylosoma* has so far not been found in this amphibian. Occasionally in the edible frog, trypanosomata may be present in addition to the presence both of *drepanidium* and *dactylosoma*. The parasites agree with all the main characteristics of the hæmosporidia of cold-blooded animals.

A considerable amount of time has been devoted to the study of these different forms and their relationships. My own observations would appear to show that *drepanidium* and *dactylosoma* are distinct parasites, and that the latter—*dactylosoma*—shows at different times certain features suggestive of a trypanosoma stage in its life-history.

A number of my preparations have shown parasites resembling those described by Billet in 1904.

In my next report I hope to be able to describe my results in full and to trace the development of these parasites.

HÆMOGREGARINES IN REPTILES.

Parasites have been found in several varieties of green snakes and the cobra found on the island of Hong Kong. They have not yet been studied in detail.

SPECIES OF RATS AND FLEAS IN HONG KONG.

In accordance with the instructions of the Honourable the Principal Civil Medical Officer, the Assistant Bacteriologist, Dr. C. M. Heanley, and the Colonial Veterinary Surgeon, Mr. Adam Gibson, commenced an inquiry into the species of rats and rat fleas in Hong Kong. The investigation was carried out partly in the Public Mortuary and partly in the Bacteriological Institute.

The following is a *résumé* of their results:—

Introductory.—To determine with accuracy the particular species of every rat brought to the Public Mortuary for examination is by no means easy. In by far the

greater number of cases, an opinion can be given with certainty, but there remains something like 20 per cent. which are difficult to recognise. This is due to several causes. (1) The young of both the common rats are very much alike, not only in size but in outline and colouring. The typical characteristics of the different species are only attained by the adult animal. (2) Some of the rats show the long ears of *Mus rattus* with the short coarse tail of *Mus decumanus*. The possibility is that these nondescripts are hybrids. Of late years considerable attention has been given to rats, and some who have worked in this connection have been reluctant to give to every rat a place in any particular species. Captain W. G. Liston, I.M.S., in a paper read before the Bombay Natural History Society in November, 1904, homologates the opinion that "it might be as easy to classify pie-dogs as rats in Bombay." A somewhat similar opinion is expressed by Kitasato in the Philippine Journal of Science, June, 1906, where he states, when speaking of different breeds of rats and their relation to plague, "Moreover, the results of biological researches tend to confirm the fact that although two distinct species of rats are found, the one most prevalent in Japan is a race which is a mixture of the two."

Species of Rats.—The following are the species of rats we have found in Hong Kong:—*Mus rattus*, *Mus decumanus*, *Mus musculus*, and the so-called "musk rat," which is not a rat, but a shrew—the *Sorex giganteus*.

Comparative Frequency of Species.—Taking the undecomposed rats which have been brought to the Public Mortuary during the last two months of 1906, as indicative of the comparative numbers of each species in Hong Kong, we find roughly the following percentages:—

Black rats— <i>Mus rattus</i>	...	...	...	...	12	per cent.
Brown rats— <i>Mus decumanus</i>	...	...	...	...	18	"
Mice— <i>Mus musculus</i>	...	...	...	...	48	"
Musk rats— <i>Sorex giganteus</i>	...	...	...	...	2	"
Undetermined rats—size of <i>Mus rattus</i>	...	...	...	...	5	"
Baby rats—undetermined	...	...	...	...	15	"

SPECIES OF FLEAS.

Seasonal Prevalence.—During the latter end of the year 1906, we have had great difficulty in finding fleas. The great majority of the rats brought to the Public Mortuary are obtained by killing or catching on bird-lime. A hundred have been searched consecutively without finding a flea. Probably the fleas have left them. Only a limited number of rats have been obtained alive and very few of these have had fleas. When catching fleas for the Indian Plague Commission in July of last year, one of us had no difficulty in finding two or three a day on the same number of rats as are now arriving. They were found both on live and dead rats. The number of fleas we have got is consequently small and the number of varieties we have found is perhaps incomplete.

Method of Identification.—Until recently little interest has been taken in the subject of fleas, and the books we have on the subject are at variance and their descriptions are incomplete. In identifying the fleas we have used the figures and descriptions given by the well-known authority on mosquitoes, G. M. Giles, in the Journal of Tropical Medicine, July, 1906. It is worth mentioning that he does not take upon himself to identify fleas, but obtains the personal assistance of the authority on the group, the Hon. Mr. Charles Rothschild. The descriptions and figures are very lucid, and enable us to identify with practical certainty four species:—

1. *Ctenopsylla musculi*.—This is the mouse flea. It is just now [December, 1906] the one most commonly found on rats and mice in Hong Kong. We have taken it on *Mus decumanus* and on mice, but much more frequently on *Mus rattus*.

2. *Pulex serraticeps*, vel *Felis*.—This is the dog flea, and we have found it on *Mus decumanus* once, and also on a dog and a man.

3. *Ceratophyllus fasciatus*.—We have only met with this flea once. It is said to be a common flea of rats.

4. *Pulex pallidus*—*Pulex Cheopis Roths.*—This is a flea we have taken in large numbers. As many as 40 have been caught on two rats of the species *decumanus*. It has also been found on *Mus rattus* and the musk rat.

CATTLE DISEASE IN HONG KONG.

I have little to add to the investigations already published by Mr. A. Gibson, the Colonial Veterinary Surgeon, and myself in 1903 and 1904—*vide* Sessional Papers No. 40 of 1903 and 42 of 1904.

Every outbreak has been examined as carefully as possible, but so far anything but encouraging results have been obtained. Rinderpest and hæmorrhagic septicæmia are both common, and may be found together in any one outbreak. I can find no clue to the causal agent of rinderpest, and have some doubt now as to the diplobacillary nature of hæmorrhagic septicæmia, especially after the recent exhaustive researches of Salmon and Smith in America. Again, these two diseases are often complicated by the presence of pyroplasmosis and trypanosomiasis, and this is specially so when the virulent blood method is used for treatment. With the admixture of these diseases, factors of so great a disturbing nature have been introduced into our investigations that little or no hope can be held out for success at present along the lines of serum therapeutics.

It has been suggested recently by the Hon. Dr. Atkinson, the Principal Civil Medical Officer, that rinderpest or any of the other diseases may be conveyed from animal to animal by a species of "biting fly." These flies are extremely common in the Colony, and would appear to be a variety of stomoxys, probably the *Stomoxys calcitrans*. Such a conveyance is highly probable. This fly has been held responsible for the conveyance of surra by Curry, Salomon and Stiles. It is intended to carry out at once a series of experiments along these lines with the hope of alighting on a causal agent while it may pass through its probable host, the biting fly.

DYSENTERY IN HONG KONG.

During the past six months a considerable amount of research work has been carried out in regard to the types of dysentery met with in the Colony and the relation of the disease to the etiology of hepatic abscess.

The amœbic and epidemic or bacillary forms of dysentery both occur in Hong Kong. The former would appear to be the less prevalent variety.

The bacillary form has been studied in regard to the types of organisms which may be isolated from the intestinal tract, &c., in different cases.

Different stems of the dysentery bacillus have been obtained, both from Japan and Manila, for purposes of comparison with those found in Hong Kong.

By using the fermentation methods of identification, *i.e.*, the action of our strains on the different sugars as dextrose, maltose, lactose, &c., it was soon found that the results are very complicated, and at the same time variable. Again, by the use of the indol reaction, agglutination, &c., the results are not entirely in accord. Up to the present we are unable to record anything definite, owing to the contradictory nature of our results, but in the course of a few months hope to arrive at some conclusion. Although the dysentery bacillus is, according to Japanese authorities and others, roughly divided into acid and non-acid types, it would appear, in the presence of other para and pseudo varieties of the bacillus, that there still remains much research to be undertaken before a final conclusion is arrived at as to the exact causal agent of the disease.

The question of the occurrence of liver abscess in Hong Kong and its etiology I propose to deal with in a special report. The exact significance of the amœbæ in the production of the abscess is still *sub judice*, and, with our increasing knowledge of these protozoa and their behaviour on artificial media, I am driven to the opinion that they alone are probably not responsible for the disease, but that they act jointly and symbiotically with other micro-organisms.

No. 8 in Appendix VII.

HONG KONG.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received November 15, 1907.)

MY LORD,

Government House, Hong Kong, October 12, 1907.

I HAVE the honour to forward a report by Dr. William Hunter, the Government Bacteriologist, on the investigations made by him during the months of April to September last, with a copy of a covering minute by the Principal Civil Medical Officer.

I have, &c.,

F. D. LUGARD,

Governor, &c.

Enclosure 1 in No. 8 in Appendix VII.

THE HÆMOSPORIDIA OF FROGS.

In my report, dated the 12th April, 1907, I drew attention to the presence in amphibians, in Hong Kong and neighbourhood, of hæmosporidia, namely, dactylosoma and drepanidium. In that report I found it impossible to make any statement of a definite nature regarding their life-history, their relationships to each other, and their behaviour when preserved in culture media outside the body of their host. The opinion was mooted, however, that, in all probability, the parasites were distinct, and that the dactylosoma might have as a phase of its life-cycle, or be a phase in the natural development of, a trypanosoma. During the past six months, a number of observations and experiments have been made with the edible frog and the so-called rock frog. In the former both parasites (or two cycles of development of one parasite) are invariably found together. In the latter, drepanidium is usually found alone.

By careful microscopic examination of the blood, spleen, bone marrow, &c., of the edible and the rock frog, it has been possible to follow out—up to a certain point—the full development of these parasites.

One can see the dactylosoma developing in the blood in a manner similar to that of the proteosoma. Further, another variety of development can be easily observed, corresponding with that described as belonging to the species *Drepanidium vanarum*, namely, the ultimate formation of cysts, containing minute oat-seed-like sporozoites, which are eventually set free and invade other red blood corpuscles.

Attached are rough sketches* of the forms of these parasites as found in the frog's blood and an attempt is also made to show their hæmic cycle of development. The one—Figure No. I.—is what is generally recognised as dactylosoma—its cycle ending in schizogony; the other is that known as drepanidium, developing by the method of Sporogony—*vide* Figure No. II.

Such a division, so far as the cycle of development is concerned, can be followed out completely by anyone possessing the necessary number of frogs at disposal—dactylosoma ending in schizogony and drepanidium ending in sporogony.

However, what has now to be considered is the relationship between these two developmentally distinct forms.

As already noted, in the edible or water frog (*Rana esculenta*?) both forms are found. On the other hand, the rock or non-edible frog rarely shows what is generally recognised as dactylosoma parasites. In this amphibian, forms typical of drepanidium are found in the blood corpuscles, the majority of which are large in size, displacing the nucleus, and show little variety in their microscopic appearance. I have compared many of them obtained from a large number of frogs with specimens of typical drepanidium preparations, supplied by the London School of Tropical Medicine, and found them to correspond in every respect—*vide* Figure No. III.

These parasites, therefore, differed from the majority of the forms met with in the edible frog—forms which I had up until recently distinguished, as far as

* Not reproduced.

possible, as the dactylosoma and the drepanidium. even although similar large parasites were found but which were regarded as part of the drepanidium cycle of development.

I, therefore, suspected that the parasite found in the rock frog—a typical so-called drepanidium—was something different from those usually found in the edible frog, and, in order to obtain more definite information on the question, I attempted to cultivate or preserve the parasites outside the body in some form of culture medium.

For the cultivation of such parasites, *e.g.*, trypanosomes, hæmosporidia, &c., a number of different nutrient media have been recommended from time to time. The methods of Novy and McNeal, Lewis and Williams, Laveran and Mesnil, Rabinowitsch, &c., have all been extensively employed and have given fair results. The majority of these methods were tried in the laboratory, but, eventually, it was found that, by the use of citrated broth, excellent preparations could be obtained revealing the extra-corporeal existence and development of these and other similar parasites.

In the case of parasites of the frog, the difficulty, up to the present, has been the presence of bacteria of contamination, which upsets the growth of the parasites under consideration. In order to avoid this, the greatest of technical care must be exercised. It matters but little if those intra-corpuseular bacteria—namely, the *Cytoamœbæ bacterifera* of Labbé—are present, as they show little tendency to further multiplication in the culture media.

The method which I have employed is as follows:—

The frogs are killed by chloroform and pinned on a flat board. With sterilised instruments the heart is laid bare. The surface of the latter is sterilised by means of a hot spatula or other convenient instrument, and then by the use of a sterilised Pasteur's pipette the contained blood is withdrawn and immediately transferred to the culture medium. If this is done with an ordinary amount of careful technique, little difficulty will be found in obtaining pure cultures, or at least cultures free from ordinary extraneous micro-organisms. As already mentioned, the *Cytoamœbæ bacterifera* show little tendency to multiply in ordinary culture media.

The culture medium which I have used most extensively is citrated beef broth, *i.e.*, ordinary neutral (+ 10) peptone broth, to which has been added 1 to 1.5 per cent. of citrate of sodium.

After the blood has been added to the tubes it gradually settles as a deposit, leaving the supernatant broth clear in colour. The tubes are incubated at a temperature of 20° to 25° C. Should the supernatant fluid subsequently become cloudy, the tube may be set aside as useless.

In addition to the inoculation of several tubes of the broth from each frog, I have always made several microscopic smear preparations from the blood, spleen, &c., in order to determine, with some degree of accuracy, the particular kind or kinds of blood parasites present. Many frogs harbour dactylosoma, drepanidia, and trypanosomata. Others show the parasites singly and this is borne out by the results of cultivation. (Single species of parasites in frogs is rare, and involves the examination of a large number of animals.)

The following results have been obtained by the use of these methods of cultivation:—

The examination of the culture tubes has to be carried out with care. The supernatant clear broth is pipetted off, and smear and wet film preparations are best made from the surface of the blood deposit. Up to the end of 24-48 hours the deposit is usually granular and watery, so that films can be made with ease; but after this time it becomes thick, mucoid, and jelly-like.

The smear preparations were always stained by Leishmann's method.

In order to avoid a lengthy description of the forms found, I have attempted on the Figure No. IV. to illustrate the changes which I have been able to follow in dactylosoma.

Nos. 1 to 4 are young forms—No. 1 being a typical sickle-shaped body. They are most numerous during the first 24 hours.

Nos. 5 to 11 are the forms found 48 to 72 hours after the inoculation. At this time almost all the parasites show some stage of multiplication. They are actively motile.

From this time onwards, the organisms can be kept alive for 6 to 10 days, but

during this time they show little change in appearance, and become embedded in the deposit, which, as already noted, has become thick and jelly-like in consistency.

Eventually they undergo granular degeneration and disappear.

Attempts were made to cultivate the typical drepanidium forms which are found alone in the rock frog. The technique employed was the same as that already described. A large number of frogs were used, but in every case a subsequent examination of the culture tubes showed the organisms still in the red blood corpuscles, or, if free, they were practically unaltered in appearance. There was never any sign of a trypanosoma development.

As a result of my investigations to date, it would appear that, in the edible frog (*Rana esculenta*?), dactylosoma shows both a schizogonous, and a sporogonous cycle of development, and that it may have as a stage in its life-history a trypanoplasma- or crithidia-like appearance. The conveyance of the parasite to the frog is most probably through the bite of some blood-sucking insect, in which this crithidial-like stage may reach its most typical development. Drepanidium, as usually seen and described, may be a distinct parasite. It might be, of course, some form—?resting—of dactylosoma. It shows no tendency to further development on cultivation.

WILLIAM HUNTER.

TRYPANOSOMA ROTATORIUM.

Its Cultivation and Results.

In my report for the previous six months, I drew attention to the main characteristics of this trypanosome, found in the edible frog (? *Rana esculenta*), an amphibian present in enormous numbers on the island of Hong Kong. Since then I have endeavoured to follow out the changes undergone by this organism outside the body of its host—mainly by the use of special culture media. Mention has already been made, under the heading of Hæmosporidia, of the media which have been employed.

Citrated beef broth (1 to 1.5 per cent. sodium citrate) has given satisfactory results. That of Novy and McNeal has also produced excellent preparations, especially in equal parts of rabbit's blood and agar.

One of the main difficulties met with is to obtain pure cultivations of the trypanosome. This is an absolute essential. Any tube showing cloudiness after incubation may be at once discarded as useless. By following the directions given under the heading of the Hæmosporidia, however, this technical error will, in the majority of cases, be found easy to avoid. The amount of blood transferred to each tube of broth, or even McNeal's media, ought to be at least 5 c.c.; more than this is an advantage rather than a drawback. These amounts are necessary, as it often happens that the trypanosomes in the frog's blood are few in numbers.

The incubation temperature is found to be 20-25° C. in order to obtain the best results. High temperatures, *e.g.*, 37° C. or over, arrest the development of the trypanosomes almost at once, and kills them completely in 48-72 hours. Similarly, low temperatures, obtained by ice, arrest their development.

The trypanosomes may be kept alive for a considerable period of time, especially on culture media like that of Novy and McNeal. In citrated broth, they live for periods varying from 10 days to a month. On solid media, however, I have found them alive up to the end of two months. It is highly probable that, with some slight alteration in the constitution of the culture medium, their life in cultures would be very much longer.

In broth cultures the largest number of organisms is found after three days' incubation; on solid method they are most numerous between the 15th and 20th day of incubation.

The cultures were examined day by day, both wet film preparations and smears, stained either by Leishmann's or Giemsa's method, being made.

Attached is a diagram* upon which I have attempted to illustrate the forms which the organism assumes upon the culture media.

* Not reproduced.

The examination by means of wet-film preparations shows the different forms of the trypanosome only. The nucleus, centrosome, and undulating membrane are scarcely visible, but the flagellum, which in most cases is long, can usually be seen, and is very active.

In young cultures the forms found are usually oval, fusiform, or spindle-shaped. (Figs. 4, 5, and 12.) In stained preparations, these show a deep blue protoplasm beset with granules. The nucleus is well defined, and varies somewhat in position. It is usually more or less central, with an inclination, in different parasites, towards the anterior or posterior extremity of the organism.

The centrosome is always clear, and stains very deeply. In practically every form it is situated anteriorly, and in close opposition, to the nucleus. Springing from it, the flagellum may be seen.

In certain instances the blepharoblast may be placed laterally or even posteriorly to the nucleus, but this is exceptional (? herpetomonas forms).

By continued observation, and in well-developed cultures, other forms are found which show the presence of a distinct undulating membrane. (Figures 6, 11, 13, and 14.) These must be regarded as more or less adult forms of the parasite. They are actively motile, and vary much in size and shape.

The multiplication of the trypanosome would appear to take place usually by longitudinal fission, and forms showing two nuclei, two centrosomes, and two flagella, are frequently found in well-developed cultures. (Figure 7). The division of the nucleus precedes that of the centrosome. In other cases elongated forms are found. (Figure 10.)

Agglomerations of the organisms are also found in young and old cultures. (Figures 8 and 9.)

In older cultures forms showing signs of division with fragmented and vacuolated protoplasm are to be seen. (Figures 15 and 16.)

In young cultures (broth in 24 hours, solid media in 2-3 days), forms are found which are more or less rounded, with granular protoplasm, and showing little or no trace of an undulating membrane or flagellum. (Figures 1 and 2.) They resemble the amœbid forms of trypanosomes first described by Plimmer and Bradford, and those figured by Laveran and Mesnil as occurring when the *Trypanosoma brucei* was living in unfavourable conditions. Their significance is by no means clear. Many investigators regard them as involution forms.

In my own cultures they show a distinct and well-staining nucleus with apposed deep-coloured centrosome. In many cases they also display a distinct tendency to division. (Figure 2.) They may even show a distinct undulating membrane. (Figure 3.) From my own investigations they would not appear to represent forms of resistance—encysted forms—as suggested by Prowazek, Thiroux, and Bouet.

In older cultures they are, for the most part, absent. From what I have seen, they would appear to represent young forms of the trypanosoma which, under certain circumstances, develop into the mature parasite. Forms similar to these have not been observed in the blood of the frog itself, although in the case of other trypanosomes, they are often found, *e.g.*, the nagana parasite in the rat. They are rare in the spleen.

WILLIAM HUNTER.

TRYPANOSOMA ROTATORIUM.

[*A Variety found in the Rock Frog.*]

This trypanosome differs from the form found in the edible frog—described in my last six-monthly report.

It is usually faw-shaped, but long thin forms are also seen. Spherical forms are found in which nuclear division is often seen with retraction of the membrane. It varies in size, but in general is smaller than those found in the edible frog.

The protoplasm is very granular with vacuoles, but not striated.

The blepharoplast lies close to the nucleus, and a broad undulating membrane, more or less surrounds the entire body of the organism.

On the attached diagram I have attempted to record the forms of the organism usually met with in the blood and spleen of the frog.

WILLIAM HUNTER.

THE INTRODUCTION OF PLAGUE BY FEEDING.

In my report on Epidemic and Epizootic Plague, published in 1904, I discussed, more or less fully, the modes of transmission of plague to man and to animals. From my clinical and pathological experience I showed that, in addition to the well-recognised types of plague, there existed another, namely, a gastro-intestinal form, and that this variety is found both in man and in animals.

Apart from the work of Wilm, there is little or no evidence in scientific literature regarding this type of the disease up to the year 1898, when the Austrian Plague Commission showed that, if large amounts of plague-infected material were used, intestinal plague could be produced. By using legitimate doses of the virus, on the other hand, feeding experiments were also successful, but the channel of infection was practically always through the mucous membrane of the mouth.

In 1899 the German Plague Commission also brought forward evidence of the induction of plague through feeding, the experiments showing that in almost all cases the channel of entry of the *B. pestis* was via the mouth, nose, or throat, and not the gastro-intestinal tract.

In 1901 Kolle, after an extensive series of experiments, concluded that plague was spread amongst rats by their gnawing the dead plague-infected corpses of other rats. By soaking bread with cultures and tissues, choke full of *B. pestis*, he succeeded in showing, in white rats, not only the presence of cervical buboes, but also well-marked intestinal lesions due to the *B. pestis* and mesenteric bubonic formations.

From these investigations it seemed highly probable that the intestine in man and in animals might play a rôle in the conveyance of plague infection. On my arrival in Hong Kong, nearly six years ago, I took up the question from this particular standpoint, and since then have carried out, from time to time, and throughout various epidemics, a large number of experiments which bear directly upon this special subject.

In 1902 I was in Hong Kong when Professor Simpson carried out his plague experiments. He fed a most varied series of animals—oxen, sheep, pigs, fowls, rats, &c.—with human tissues and cultures teeming with *B. pestis*. His results have already been made known to science in his "Report on the causes and continuance of Plague in Hong Kong, 1903," and his excellent Treatise on Plague, published in 1905.

There would appear to be an element of scepticism in the minds of many plague specialists as to the exact value of these experiments, and the proper interpretation to put upon them. As I was a witness to most of them, the following remarks may clarify the somewhat incomplete description of these experiments given by Professor Simpson in his necessarily contracted reports.

There is no doubt about the animals, upon which he experimented, having died of plague. Professor Simpson used calves, pigs, sheep, fowls, &c., which in nature are practically insusceptible to plague infection. No one doubts their insusceptibility, but such an immunity is not absolute, and the production of the disease in such animals must be regarded as simple induction of plague in animals, insusceptible to the disease, by the administration of enormous doses of highly infective material which eventually overcame the natural, but not absolute, insusceptibility.

Simpson certainly used enormous doses and, although correct in his post-mortem and bacteriological results, interpreted his findings in a manner somewhat dogmatic, and not quite in harmony with what is generally recognised by plague specialists of the present day. He states his case much too strongly when he pronounces the possibility of the conveyance of plague to man from cattle, pigs, sheep, fowls, &c. In my experience it is certainly possible to induce the disease in these animals, but, as a factor to be reckoned with in a plague-infected area, it is of practically no great significance. I have never seen, or heard, from authentic sources, of the occurrence of naturally induced plague infection in bovines, sheep, pigs, and fowls or other animals commonly consumed by man as food.

The production of plague in the animals used by Simpson was but a question of dosage, and, as a result, it is not surprising that the experiments of Haffkine, Bannerman, &c., were not confirmatory.

In 1903 Hetsch and Otto, when testing the "Paris Plague Serum" on rats, had little difficulty in inducing fatal plague infection *per os* with plague tissues in at least 86 per cent. of their animals.

In 1905 Kister and Schumacher showed that by feeding rats with plague-infected material, the bubonic variety was produced if spicules of bone were present in the bolus, thus producing a lesion of the buccal mucous membrane; an intestinal variety, however, was called forth if soft food was mixed with the virus.

In 1906 Berestneff fed white rats with the organs and tissues of plague-infected guinea pigs. The majority showed an intestinal infection, with affection of the Peyer's patches, hæmorrhages, &c., and the occurrence of mesenteric buboes.

Klein, in 1906, published an exhaustive series of experiments, showing that fresh plague-infected tissues and cultures of the *B. pestis* fail even to produce the disease in animals, such as guinea pigs, white rats, and mice. Dried cultures and organs, however, not only induce the disease, but set up a typical intestinal plague in the same variety of animals.

The second report of the Commissioners at present engaged in Plague Investigation in India (1907) shows that, by feeding, it is possible to infect rats and produce intestinal and mesenteric plague lesions. In nature, however, intestinal infection rarely, if ever, takes place.

To sum up, therefore, from the investigations made up to the present time, it would appear that, according to the Austrian and German Plague Commissions, feeding experiments do not induce intestinal plague, except when the material is administered in large doses or a stomach tube is used (Austrian); according to Kolle, Simpson, Kister and Schumacher, Berestneff, and the present Indian Plague Commissioners, intestinal plague is induced by feeding with fresh plague-infected materials, either alone or mixed with some food; and, lastly, according to Klein, fresh plague tissues or cultures fail to induce plague in experimental animals, but when preserved or dried and mixed with rice or wheat, produce typical intestinal plague.

PERSONAL OBSERVATIONS.

A.—EXPERIMENTS ON GUINEA PIGS.

The guinea pigs used for these experiments weighed on an average 200-300 grammes. Before being used for experimentation, the animals were isolated for at least a week for purposes of observation.

Series No. I.

Feeding with fresh human tissues teeming with B. pestis.

Method: A small piece of fresh spleen from a plague cadaver was obtained, and on microscopic examination found to be full of *B. pestis*. The tissue was then pounded up in a clean mortar, and more or less definitely weighed portions of the pulp were mixed with boiled and ground rice in sterile dishes. The rice was specially selected in order to avoid the possibility of the presence of sharp spicules which might injure the mucous membrane of the mouth, &c. Previous to each feeding experiment the animals were kept without food for at least 18-24 hours. Care was also taken to observe whether each animal consumed the whole of the bolus. Those which did not partake of the greater part were set aside, and, if they did not die or develop plague within a month, were killed for post-mortem and bacteriological observation. Subsequent to the feed the animals were transferred to clean cages and kept under observation.

Table No. 1 is a record of the main results. Many other similar experiments have been made by me during the past few years, and the results were uniform and identical. In addition to each series of these feeding experiments, a healthy guinea pig was pricked with some of the same material. In every instance the animal developed typical plague.

Spleens from different cases of human plague were used, but the effect produced on the guinea pigs was practically the same throughout. The virulence of the bacillus in different cases of human plague, when tested on guinea pigs did not appear to vary much. In general the guinea pigs died in from 3-6 days after feeding.

The post-mortem lesions found consist chiefly of generalised congestion and inflammation of the organs and tissues with hæmorrhages and degeneration. Buboes in the neck, axillæ and groins are also found either alone or with intestinal

changes, and *vice versa*. In animals showing typical intestinal plague, the changes found in the abdominal cavity are very striking. Hæmorrhages are scattered broadcast throughout the contained viscera. The Peyer's patches and lymph follicles are enlarged, reddened, may be ulcerated. They may contain hæmorrhages like the wall of the gut. The mesentery shows enlarged glands with general congestion, and frequently the presence of a distinct and well-developed bubonic formation. Cultures and smear preparations from the intestine and its walls, the glands, and other abdominal organs show the presence of abundant plague bacilli.

The internal organs of several of these guinea pigs have been preserved by the Kaiserling method, in the laboratory, and show the changes in a striking fashion.

The conclusions to be drawn from these experiments are:—

- (1) *Feeding with fresh spleen pulp teeming with B. pestis induces plague in guinea pigs.*
- (2) *The path of infection varies—it is as often intestinal as buccal.*
- (3) *Guinea pigs may suffer from primary intestinal plague when fed in the laboratory. What obtains in nature we are unable to say.*

Series No. II.

Feeding with fresh guinea pig tissues, e.g., the spleen, teeming with the B. pestis.

A large number of guinea pigs was used for these observations, which were found to be in harmony with those already detailed under Series No. I.

By working the guinea pig strain of the bacillus through a number of these animals, no alteration in virulence was observed.

Series No. III.

Feeding with fresh white rat tissues, teeming with the B. pestis.

The results obtained were identical with those of the foregoing.

Series No. IV.

Feeding with fresh bouillon cultures of the B. pestis, derived from human, rat, and guinea pig cadavers.

All the cultures used had been previously tested as to their virulence, which was maintained high throughout the whole series of experiments. The broth cultures were in each case 48 hours old, incubated at 37° C. and of + 10A. alkalinity.

The technique of these experiments was similar to that already described under Series No. I.—varying quantities of the culture in cubic centimetres being mixed with boiled ground rice. The results of the majority of the experiments are given in Table No. II. Others were made from time to time, at varying periods, yielding similar results, and therefore need not be recorded.

The conclusions to be drawn from these experiments are:—

- (1) *Feeding guinea pigs with broth cultures of the B. pestis frequently induces the disease.*
- (2) *The type of the disease produced is either acute septic plague, bubonic plague, or intestinal plague.*
- (3) *The type of the disease is to a certain extent dependent upon the dose, but this is found to be very variable.*
- (4) *The production of intestinal plague by broth cultures is very uncertain and obtains only as a laboratory experiment.*

Series No. V.

A similar series of experiments was made with *milk cultures of the B. pestis*, following as far as possible the technique described by Professor Klein in his recent treatise on plague (1906). The cultures were mixed with rice as before.

The results were extremely variable and may be compared with those described under Series No. IV. The animals, to which large doses were administered, invariably died of plague, either bubonic, septic or intestinal.

Series No. VI.

Feeding guinea pigs with virulent agar cultures (+ 10 A.) of the B. pestis, derived from guinea pig, rat, and human cadavers.

The cultures were prepared from the heart-blood of guinea pigs which had succumbed to acute septic plague—subcutaneous inoculation—within 36 hours. After the inoculation of each tube of agar—each containing 6-8 c.c. of media on slant—the water of condensation was run over the line of inoculation, thus securing a broad surface growth, more or less covering the whole of the slant surface.

The technique employed was practically the same as that already described under Series No. IV., only the tubes had to be broken in order to get at the agar cultures. The quantities used for each experiment are approximate. In fact, Klein's technique was followed as closely as possible.

An epitome of these experiments is given in Table No. III.

The post-mortem appearance of those animals which succumbed to typical intestinal plague was very marked. The abdominal organs were all in a condition of deep congestion. The ileum was usually black-red in colour. The omentum and the peritoneal lining were œdematous and studded with hæmorrhages of variable size. Petechial spots and large extravasations of blood were found throughout the walls of the ileum. The Peyer's patches were swollen and contained, or were surrounded by, hæmorrhages. The glands in the mesentery varied in their appearance. In many instances the changes amounted only to enlargement with congestion. In other cases they were softened and contained hæmorrhages and serous fluid, and as such combined to form a distinct bubo.

These experiments appear to show—*That plague in its various forms may be produced in guinea pigs by feeding with agar-agar cultures of the B. pestis. Young cultures call forth the disease with greater uncertainty than cultures of greater age. Young cultures would appear to produce usually the bubonic or septic types of the disease. Older cultures, however, very frequently set up typical intestinal plague with a mesenteric bubo.*

Series No. VII.

Feeding guinea pigs with organs and tissues of plague cadavers, and cultures of the B. pestis, mixed with boiled ground rice, and dried over sulphuric acid.

In the case of the organs and tissues, the pieces selected for experiment were previously ground up in a mortar, and then well mixed with the rice in sterilised plate dishes. The cultures—both bouillon and agar-agar—were in every case 48 hours old and incubated at 36-37° C. They were poured over the rice and thoroughly mixed, with clean glass rods, through the rice, before placing the dishes before the animals. In order to put to the test the exact value of Klein's results with dried tissues and cultures, only small doses or amounts of culture and tissue were used uniformly throughout the experiments.

The other details, as regards technique, are exactly similar to that already described under Series No. I.

Table No. IV. is a protocol of the main experiments made with plague organs dried over sulphuric acid.

Intestinal plague is invariably set up by such a method of feeding, and my results are in more or less perfect harmony with those already described by Professor Klein.

It was found, further, that if the drying was prolonged for a period longer than 36 to 48 hours, the results obtained were entirely unsatisfactory.

A certain number of experiments on guinea pigs were also made with plague organs and tissues (human) which had been cut into fairly large pieces, and dried over sulphuric acid. The administration of such material, unmixed with rice, to hungry guinea pigs, invariably resulted in the production of typical acute intestinal plague. A special table, giving the protocol of these experiments, would appear to be unnecessary. They confirm the experiments made by Professor Klein in Series No. III.

Table No. V. is a résumé of the main experiments made with cultures of the *B. pestis*, under this series. *The results agree, in the main, with those already described by Professor Klein.*

B.—EXPERIMENTS ON WHITE RATS.

Almost all the rats used for the experiments were bred in the Bacteriological Institute, and had been under observation for a long time.

The experiments made upon these animals were of a nature exactly similar to those already described under "Observations on Guinea pigs." They were not, however, of such a comprehensive nature, owing to the limited supply of white rats in the Colony at the commencement of my experiments. Later on my experiments with these rodents were carried on simultaneously with those on guinea pigs. In all about 80 rats were used.

With these preliminary remarks, it appears to me to be quite unnecessary to give the full details of the experiments carried out.

The following protocol would appear sufficient:—

*Series No. I.**Feeding with fresh plague-infected human organs.*

The results showed that a large proportion of the rats succumbed to intestinal plague. Many, also, died of bubonic pest.

*Series No. II.**Feeding with the organs and tissues of white rats teeming with the B. pestis.*

The results obtained were similar to those of Series No. I.

*Series No. III.**Feeding with bouillon cultures of the B. pestis.*

The most frequent form of the disease set up by these cultures was found to be either bubonic plague with cervical or other buboes, or acute septic plague. Intestinal plague may be also obtained in a certain proportion of the cases.

*Series No. IV.**Feeding white rats with agar cultures of the B. pestis, obtained chiefly from the heart-blood of white rats which had succumbed to acute septic plague.*

The results showed that old cultures—3 to 6 weeks—invariably set up intestinal plague. Young cultures, on the other hand, may also induce the disease, the type of which is commonly the bubonic variety.

*Series No. V.**Feeding white rats with dried plague organs or cultures of the B. pestis.*

My results are similar to those obtained by Professor Klein.

GENERAL CONCLUSIONS.

The foregoing experiments clearly show that by feeding guinea pigs and white rats with fresh or dried plague organs or tissues, or cultures of the *B. pestis*, plague may be induced. The particular type of the disease produced, however, varies within certain limits. *Fresh or dried plague organs and tissues produce bubonic as well as intestinal plague. In the case of dried tissues, however, intestinal plague is the rule and not the exception, and the same may be said in regard to cultures, especially solid cultures.*

The production of intestinal plague in these rodents is of importance from an epidemiological standpoint. As Klein states, it is no uncommon occurrence for rats

to die of plague in food stores, and that fodder may have been previously infected. Again, if rats die of plague in such stores, there is very good reason to believe that these stores may remain infected for some considerable period of time.

The existence of intestinal plague in rats, in nature, is most difficult of demonstration. Most of the results obtained up to the date of writing have failed to prove its presence, although there seems no reason why it should not obtain.

There is no doubt, on the other hand, about the occasional existence of well-marked intestinal plague in man, especially in severe epidemics. Such lesions in the human subject resemble those found in the rodent. Peyer's patches are swollen with contained or surrounding hæmorrhagic extravasations. Ulcerations are usually present, and the ileum, in general, covered with petechiæ, swollen, and congested. Buboes are often found in the mesentery, of considerable size, with the hæmorrhage extending widely from all sides.

In conclusion, these experiments, coupled with the results of Professor Klein, and the recent investigations of the Indian Plague Commissioners, establish the fact, hitherto disputed, that by feeding rodents, e.g., guinea pigs, rats, &c., with plague tissues or cultures of the B. pestis, plague infection, of various types, can be induced, and that by such methods of experimentation the existence of intestinal plague is placed beyond dispute.

WILLIAM HUNTER.

TABLE NO. I.

Serial No.	No. of Guinea Pigs.	Average Amount of Spleen Pulp.	No. of Deaths on each Day.						Total.	Remarks.
			2.	3.	4.	5.	6.	7.		
1.	5	5 grms.	—	1	2	2	—	—	5	The pig which died on the third day showed general plague septicæmia with no special bubo. The two on the fourth day showed intestinal plague. Of those on the fifth day one had cervical bubonic plague, the other intestinal plague.
2	3	1 gm.	—	—	1	2	—	—	3	All showed typical intestinal plague with mesenteric buboes.
3	5	2 grms.	—	—	1	2	2	—	5	The pigs found dead on the fourth and fifth days showed cervical, axillary, and mesenteric buboes with fairly well-marked intestinal lesions. Those found dead on the sixth and seventh days showed intestinal plague.
4	6	0.5 gm.	—	—	1	2	2	—	5	The five found dead showed intestinal plague; in one cervical buboes were also present. One animal did not die, and when examined <i>post-mortem</i> one month later was quite healthy.
5	10	1 gm.	—	—	3	3	2	2	10	The pigs found dead on fourth and fifth days had cervical buboes. Those of sixth and seventh days had also a bubo in the cervical region, but mesenteric buboes were also found and typical intestinal lesions with <i>B. pestis</i> .
6	10	10 grms.	2	3	1	3	—	1	10	Those of the second day died of acute septic plague. There was direct evidence in these pigs as to the path of entry of the virus. Those of the third day had marked septic plague, but in two cervical buboes were present, in the other an axillary bubo was found. The others showed intestinal plague.

W. HUNTER.

TABLE NO. II.

No. of Guinea Pigs used.	Quantity of Broth Culture mixed with Rice and given to each Guinea Pig.	Result.	Remarks.
1	5 c.c. <i>Source.</i> —Human.	Dead in three days	Buboes were found in each axilla and in one groin. There was no mesenteric bubo. The small intestine was black with congestion and on resection showed changes typical of intestinal infection. Smears made from the intestine showed bacilli typical of plague, and this was confirmed by subsequent cultures and experiments made upon a guinea pig.
5	5 c.c. <i>Source.</i> —Guinea pig.	One dead second day. Two dead fourth day.	The guinea pig found dead on the second day died of septic plague and had a cervical bubo. There were no intestinal lesions. Of those found dead on the fourth day one showed cervical bubonic plague, the other had a cervical bubo plus intestinal lesions. Two of the pigs showed no symptoms. One was killed after a month and found to be perfectly healthy, the other was injected subcutaneously with $\frac{1}{10}$ of a c.c. of a similar broth culture and died in three days.
5	5 c.c. <i>Source.</i> —Rat.	One dead two days Two dead four days	The pig found dead in two days died of acute septic plague. One of the two found dead in four days showed intestinal plague, the other died of septic plague.
10	10 c.c. <i>Source.</i> —Human.	Five dead three days Three dead five days	The other two remained healthy. The first five died of acute septic plague with no sign of intestinal lesions. Two of the three dead after five days showed intestinal plague. The other had a cervical bubo.*
4	1 c.c. <i>Source.</i> —Human.	—	Two remained alive for one month, when they were killed and found perfectly healthy.
5	3 c.c. <i>Source.</i> —Guinea pig.	One dead three days	All remained alive and healthy.
2	2 c.c. <i>Source.</i> —Guinea pig.	One dead fourth day	This pig died of cervical bubonic plague. The others remained alive and healthy.
4	4 c.c. <i>Source.</i> —Rat.	Two dead three days	This pig showed typical intestinal plague. The other remained perfectly healthy.
			Both pigs died of cervical and axillary bubonic plague.
			The others remained healthy.

W. HUNTER.

TABLE NO. III.

No. of Guinea Pig.	Source of Culture.	Age of Culture.	Amount of Culture used.	Result. † = Death.	Remarks.
1	Guinea pig	48 hours	One whole culture.	—	Alive one month after. Killed and found healthy.
2	"	"	Two whole cultures.	—	" " " "
3	"	"	Three whole cultures.	—	" " " "
4	"	"	"	—	" " " "
5	"	"	"	†	Dead in three days. Cervical bubo. Septic plague.
6	"	"	"	—	Alive and healthy two months after.
7	"	"	"	†	Lived for four days. Groin and cervical buboes. Congested ileum with enlarged lymph follicles. Intestinal scrapings showed plague bacilli and by cutaneous inoculation of other pigs produced plague.

No. of Guinea Pig.	Source of Culture.	Age of Culture.	Amount of Culture used.	Result. † = Death.	Remarks.
8	Guinea pig	24 hours	Three whole cultures.	†	Died in three days, showing well-marked intestinal plague. Identical with the results obtained in the nine pigs used for the experiments of Series No. IV.
9	"	"	Four whole cultures.	†	Dead in two and a-half days. Multiple buboes. Intestinal lesions.
10	"	72 hours	One culture	†	Lived three and a-half days. Cervical bubonic plague.
11	"	"	"	†	Lived two days only. Cervical bubonic plague.
12	"	"	Half culture	—	No result. Killed in one month—found healthy.
13	"	"	Two cultures.	†	Dead in four days of cervical bubonic plague. No evidence of intestinal lesions.
14	"	"	Three cultures.	†	Dead in three days. Well-marked intestinal plague with mesenteric bubo.
15	"	One week	Half culture	†	Died in four days of bubonic plague. There were slight signs of intestinal lesions. Similar to 9, pig No. 7.
16	"	"	One culture	†	Died in two and a-half days of cervical bubonic plague.
17	"	"	"	†	Died in three days of intestinal plague. No buboes.
18	"	"	Two cultures.	†	Dead in four days, showing typical intestinal plague. No buboes.
19	"	"	"	†	Dead in four days, showing typical intestinal plague. Bubo in mesentery.
20	"	"	Three cultures.	†	Died in three days of acute cervical bubonic and septic plague. No intestinal lesions.
21	"	Two weeks	Half culture	—	Alive one month after. Killed and found healthy.
22	"	"	"	†	Dead in four days. Cervical bubo. No intestinal lesions.
23	"	"	One culture	†	Died of intestinal plague in four days with a bubo in the mesentery.
24	"	"	"	—	Alive one month after. Killed and found healthy.
25	"	"	"	†	Dead in three days. Very acute form of intestinal disease. Ileum black with congestion and the interior of the gut showed considerable ulceration. Large bubo in the mesentery.
26	"	Four weeks	Half culture	†	Dead in five days of acute septic plague.
27	"	"	"	†	Dead in three and a-half days. Intestinal plague.
28	"	"	"	†	Dead in three days. Intestinal plague.
29	"	"	Two cultures.	†	Dead in three days. Cervical bubo. Early intestinal changes found. No bubo in mesentery.
30	"	"	One culture	†	Dead in four days of intestinal plague.
31	"	"	Half culture	†	Dead in four and a-half days of intestinal plague. Mesenteric bubo also present.
32	"	Six weeks	One culture	†	Died in two and a-half days of acute intestinal plague. Results similar to those described by Klein in his Experiment No. III., rat No. 4.
33-36	"	"	"	†	All died within four days of intestinal plague. Same as No. 32.
37-38	"	"	Half culture	One †	One died in four and a-half days of intestinal plague. The other lived for two weeks, when it died. <i>Post-mortem</i> , splenic abscess containing <i>B. pestis</i> .
39-40	"	"	One culture	†	Same result as above—No 32.
41	"	"	Two cultures.	†	Died in three days. Cervical bubo. No intestinal lesions. Buccal infection.

Other experiments were made with cultures varying from six weeks to three months old. In some cases intestinal plague was produced. The results were extremely uncertain and are scarcely worthy of record.

W. HUNTER

TABLE NO. IV.

No. of Guinea Pigs used.	Nature of Plague Tissue or Culture.	Source of the Virus.	Duration of Drying over H_2SO_4 .	Result. † = Death.	Remarks.
2	Blood full of <i>B. pestis</i> .	Human. Plague septicæmia.	24 hours...	†	Both animals died in three to three and a-half days with well marked intestinal plague and mesenteric buboes.
4	Ditto with Spleen Pulp.	"	" ...	3†	Ditto. One never showed any symptoms although it was seen to have eaten the bolus.
3	Blood and Spleen Pulp.	Guinea Pig. Acute septic plague.	" ...	†	One died of acute bubonic plague in three days without intestinal lesions. The other two developed typical intestinal plague and died in four to five days.
5	Blood full of the <i>B. pestis</i> .	Acute rat plague	" ...	†	All died in from three to four days of acute intestinal plague.

W. HUNTER.

TABLE NO. V.

No. of Guinea Pigs used.	Culture.	Source of Culture.	Age of Culture.	Duration of Drying over H_2SO_4 .	Remarks.
2	Agar-agar ...	Human ...	24 hours...	48 hours..	One died in three days of acute septic plague, the other died in three and a-half days of intestinal plague.
1	" ...	" ...	Two weeks	36 hours..	Died in four days of acute intestinal plague with a typical mesenteric bubo.
2	Bouillon ...	" ...	One week	" ...	Both alive and healthy after one month.
1	Agar-agar ...	Guinea pig ...	Two weeks	48 hours...	Died in three and a-half days of acute intestinal plague.
1	" ...	White rat ...	Three weeks.	36 hours...	Died in four days.

W. HUNTER.

THE PRESERVATION OF NATURAL COLOURS IN MUSEUM PREPARATIONS.

Until a few years ago, almost all museum preparations were preserved in alcohol. The form and relations of the tissues to each other were well maintained by this method, but as a process for the fixation of the normal colours of such gross preparations it is valueless.

Much was expected by the introduction of formaldehyde, and numerous mixtures containing formalin have been recommended from time to time to improve upon the preservation of the natural colours of different organs and tissues.

In 1897, Kaiserling published an account of a method which at once marked a distinct step in advance in regard to our knowledge of such matters. The tissues were fixed in a mixture of 40 c.c. formalin, 200 c.c. water, 3 grammes potassium nitrate, and 6 grammes potassium acetate for half to several days. The normal colour of the tissues was then restored by placing the preparation in 80 per cent. alcohol.

Finally, the specimen was permanently preserved in a mixture of 20 c.c. glycerine, 10 grammes potassium acetate, and 200 c.c. water.

This method, with minor modifications, has been extensively employed in different museums throughout the world, and given good results. It certainly fixes the normal colours of different preparations, but, as most observers agree, the fixa-

tion has to be performed in the dark, and the specimens must be permanently preserved in the dark, except when on exhibition.

Notwithstanding these precautions, however, the tissues gradually lose their colour, and this is specially the case in pathological museums in tropical and sub-tropical countries. In Hong Kong, the original Kaiserling method is not of much value. The preparations rapidly become little better than ordinary alcoholic specimens.

During the past few years, it has become necessary in the east to build up pathological museums for educational purposes in connection with the various medical schools, and, as Lecturer in Pathology in the School of Medicine in Hong Kong, I have endeavoured to obtain preparations which, when treated by the glycerine-formalin method, would retain their natural colour. After considerable variations in my technique, I have obtained results which I think will compare very favourably with any hitherto reached.

My reason for the present communication is that many of the pathologists who have visited by laboratory have remarked upon the natural colour of my specimens, and expressed surprise when told that when finally mounted they are left exposed to ordinary daylight throughout a tropical summer, and that after five to six years they are quite as good as when originally set up. Several of these gentlemen have expressed a wish to have my method published. The following is my routine technique:—

The most important points would appear to be the treatment of the specimen during its spirit bath, and its ultimate preservation in pure glycerine.

The results obtainable vary according to the tissue or organ; the liver, spleen, kidney, &c., are the simplest to deal with; the gastro-intestinal tract is the most difficult to treat, especially in regard to the preservation of the natural colours of congestions, hæmorrhages, &c., which may be present throughout its length.

Generally, the process with solid organs may be prolonged indefinitely. With thin tissues, *e.g.*, the intestines, the more rapid the process the better the result.

(I) *With Solid Organs.*

Having previously trimmed the specimen roughly—

(a) Fix it in the following solution:—

Formalin, 100 c.c.
Potassium acetate, 25 grammes.
Potassium nitrate, 25 grammes.
Distilled water, 1,000 c.c.

The duration of fixation is two to three days.

Keep the specimens suspended in the fluid so that all parts of it are freely exposed to the action of the fixative. The duration of fixation varies with the size of the block of tissue, but in all cases it should be as short as possible. Light need not be excluded.

(b) Wash the block of tissue superficially in running water.

(c) Suspend the specimen in rectified spirit for several days. It would appear immaterial, within certain limits, how long the tissue is left in spirit. I usually leave it for a considerable time, *e.g.*, a week to ten days. If a good natural colour is not restored within this time, it is advisable to shave off a thin slice of the surface showing the main pathological changes, and preserve it for a few days longer in a fresh spirit bath. In most cases it is advisable to add to this second bath a few grammes of potassium acetate and nitrate, sprinkling the salts as carefully as possible over the surface of the preparation as it lies in the fluid. Such a procedure invariably results in a surface being obtained with the natural colours intact.

(d) Wash the specimen superficially in water.

(e) Transfer to the following solution for 24 to 48 hours:—

Glycerine, 250 c.c.
Potassium acetate, 25 grammes.
Potassium nitrate, 25 grammes.
Distilled water, 1,000 c.c.

(f) Transfer to the following solution for 24 hours:—

Glycerine, 250 c.c.
Distilled water, 1,000 c.c.

- (g) Place in 50 per cent. glycerine for 24 hours.
- (h) Place in 75 per cent. glycerine for 24 hours.
- (k) Preserve permanently in pure glycerine.

(II) *With Thin and Delicate Tissues, e.g., Intestines.*

- (a) Fix in the solution already mentioned for 12 to 24 hours.
- (b) Wash superficially in running water.
- (c) Suspend the specimen in rectified spirit for one to two days, adding to the bath a few grammes each of potassium nitrate and acetate.
- (d) Wash superficially in water.
- (e) Place in solution "e" (as above) for 48 to 72 hours.
- (f) Transfer to solution "f" (as above) for 48 hours, and subsequently work up the specimen gradually into pure glycerine for permanent preservation.

As already mentioned, the process with such tissues as the intestine has to be carried out rapidly. The gradual transference to glycerine must, however, be done more slowly in order to prevent as far as possible the occurrence of shrinkage.

In conclusion, it will be found that during the first few weeks after the preservation of the specimen in pure glycerine, the natural colours of the tissues will improve. This is my general experience. So far, I have never taken any precaution to prevent the access of light or even sunlight. The process is not an expensive one, as the majority of the solutions may be used several times.

I hope that the foregoing details of my method are sufficiently clear so as to enable every worker to verify it and obtain results equal to, if not better than, my own. The technique certainly requires some practice.

My excuse, if any is required, for this communication is the wish expressed by the many gentlemen who have seen my preparations to have an account of my method made known.

WILLIAM HUNTER.

Enclosure 2 in No. 8 in Appendix VII.

HONOURABLE COLONIAL SECRETARY,

REPORT from Dr. Hunter attached; the protozoological articles on the hæmosporidia and the trypanosoma of frogs are particularly interesting; those on the hæmosporidia tend to show that the dactylosoma and the drepanidium are quite distinct.

The article on the induction of plague by feeding seems to me to prove conclusively that plague may be infected through the gastro-intestinal tract. I had discussed this question very fully with Dr. Klein when at home on leave, and it occurred to me that Dr. Klein's finding that intestinal plague could be set up by feeding with dried cultures and organs might have an important bearing on the epidemiology of the disease as it occurs here, this is being still further investigated.

The final article on the preservation of natural colours in museum preparations is of much practical importance.

J. M. ATKINSON,
P. C. M. O.

October 3, 1907.

No. 9 in Appendix VII.

STRAITS SETTLEMENTS.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received May 4, 1907.)

MY LORD,

Government House, Singapore, April 10, 1907.

I HAVE the honour to forward the enclosed report of the work done in the Bacteriological Laboratory at Singapore for the six months ended the 31st ultimo.

I have, &c.,
JOHN ANDERSON.

Enclosure in No. 9 in Appendix VII.

BACTERIOLOGICAL LABORATORY.

I.—*Clinical Research.*

Total number of specimens—1,060.

1. Widal's reaction for typhoid fever—390:—

Positive	...	...	...	...	...	125
Negative	...	...	...	...	...	244
Doubtful	...	...	...	...	...	21

The standard employed was a dilution of 1 in 50 with a time limit of 30 minutes.

2. Widal's reaction for paratyphoid:—

Total number	...	...	...	...	...	18
Negative	...	...	...	...	...	17
Doubtful	...	...	...	...	...	1

The standard employed was the same as in the case of typhoid fever.

3. Blood films for malaria:—

Total number	...	...	...	...	...	374
Negative	...	...	...	...	...	226
Positive	...	...	...	...	...	148

The varieties of parasites were as follows:—

(a) Subtertian	...	...	...	...	...	94
(b) Simple tertian	...	...	...	...	...	30
(c) Double tertian	...	...	...	...	...	12
(d) Mixed tertian	...	...	...	...	...	4
(e) Simple quartan	...	...	...	...	...	6
(f) Triple quartan	...	...	...	...	...	1
(g) Mixed quartan and subtertian	...	...	...	...	...	1

4. Sputa for tubercle bacillus:—

Total	...	...	...	...	...	122
Negative	...	...	...	...	...	84
Positive	...	...	...	...	...	38

5. Smears for gonococcus:—

Total	...	...	...	...	...	32
Negative	...	...	...	...	...	18
Positive	...	...	...	...	...	14

6. Swabs for diphtheria bacillus:—

Total	...	...	...	...	...	29
Negative	...	...	...	...	...	16
Positive	...	...	...	...	...	13

7. Smears for leprosy bacillus:—

Total	...	...	...	...	...	21
Negative	...	...	...	...	...	15
Positive	...	...	...	...	...	6

8. Urines:—

Total	...	...	...	...	...	10
Normal	...	...	...	...	...	2
Casts, &c.	...	...	...	...	...	8

9. Fæces for ova, &c.:—

Total	...	...	...	...	...	8
Normal	...	...	...	...	...	7
Anchylostomum ova	...	...	...	...	...	1

10. Blood counts (differential):—

Total	...	...	...	...	...	16
Normal	...	...	...	...	...	7
Polymorphonuclear leucocytosis	...	...	...	...	...	9

11. Pus organisms:—

Total	...	...	...	...	...	6
Negative	...	...	...	...	...	3
Staphylococcus pyogenes aureus	...	...	...	...	...	3

12. Plague:—

Total	...	...	...	...	...	12	
Post mortem	...	...	...	...	...	10	all positive.
Ante mortem	...	...	...	...	...	2	{ 1 positive and 1 negative

13. Tumours, &c.:—

Gumma	...	...	...	...	...	1	
Tubercle	...	...	...	...	...	2	
Fibroma	...	...	...	...	...	1	
Carcinoma	...	...	...	...	...	2	
Epithelioma	...	...	...	...	...	2	
Cystadenoma	...	...	...	...	...	1	
Lymphosarcoma	...	...	...	...	...	1	
Fibrin (with foetal remains)	...	...	...	...	...	1	
Fibrin (alone)	...	...	...	...	...	1	

In addition to the above a very considerable number of tumours and various other specimens were examined in connection with autopsies performed at the various hospitals.

II.—*Examination of Waters.*

Total number—106.

1. Wells, &c.	...	...	...	...	...	34	
Good	...	...	...	...	...	3	
Fair	...	...	...	...	...	3	
Bad	...	...	...	...	...	28	

Those specimens characterised as bad all showed the presence of large number of organisms belonging to the Coli group.

2. Municipal water (reservoir, &c.):—

Total number	...	...	...	...	...	72	
All good or fair:	...	...	...	...	...		

A considerable number of experiments were carried out by this department during the visit of Professor Simpson.

III.—*Food Stuffs, &c.*

Total number—119.

1. Milk:—

(a) General bacteriological examination of 18 samples showed the presence of intestinal organisms in all.

(b) Examination for tubercle bacilli was carried out in five cases. In no case was the suspected organism found.

2. Aerated water, &c.	...	...	...	...	...	95	
Aerated waters	...	...	...	...	...	18	
Good	...	...	...	...	...	15	
Bad	...	...	...	...	...	3	
Other foods and drinks	...	...	...	...	...	77	
Good	...	...	...	...	...	35	
Bad	...	...	...	...	...	42	

IV.—*Miscellaneous.*

Examination of rats.—During the first three months of 1906 several hundreds of rats were examined for the presence of plague. During the last three months 250 additional rats have been examined. In no case was there any sign of acute plague, but out of the 250 examined in the latter part of the year two showed caseous glands in the axilla. Cultures and smears failed to reveal the presence of plague bacilli. Owing to the want of suitable animals no animal experiments could be carried out at that time, but suitable animals have been, and are now being, acquired. It is of importance to ascertain whether plague is present in a chronic form in the rats of the town to even the slightest extent, as its presence in these rodents might explain the origin of the few sporadic cases which occur.

Widal's reaction in cases of dysentery.—100 tests have been performed. The sera were obtained from the Pauper and General Hospitals from patients who represented the clinical symptoms of the disease. Various strains of dysentery bacilli

were employed, including one kindly supplied by Professor R. Strong, of Manila, and another by Professor W. J. Simpson. The dilution employed was 1 in 50, with a time limit of 30 minutes. In only one case was the reaction positive.

Museum.—Upwards of 100 specimens of pathological interest have been prepared by the pathologists for the museum of the Straits Medical School.

B.—*Post Mortem Examinations.*

The pathologist and his assistants now perform all post mortem examinations, including police and coroner's cases, except in the event of no Assistant Surgeons being available when the pathologist goes on leave, when these latter cases will be performed by an Assistant Surgeon or House Surgeon, as the case may be. The Assistant Surgeon or House Surgeon is to be present and is to take notes of all police and coroner's cases, and is to give evidence should it be required.

Instruction in post mortem work was given by Dr. Finlayson at Tan Tock Seng's Hospital, and by myself at the General Hospital, to the hospital students in the Straits Medical School.

The following is a list of the diseases which seemed, post mortem, to have been chiefly instrumental in causing death. Owing to the absence of the pathologist on leave and the difficulty of obtaining trained assistants, the number of post mortems performed was considerably smaller than it would otherwise have been.

Total number of post mortem examinations ... 1,193

Diseases:—

Dysentery	...	...	...	...	...	226
Tubercle, total	...	...	...	...	...	191
(a) Tubercle of lungs	...	...	...	...	...	91
(b) Tubercle of lungs and intestine	...	...	...	...	...	47
(c) General tuberculosis	...	...	...	...	...	41
(d) Military tubercle	...	...	...	...	...	1
(e) Tubercle of bones	...	...	...	...	...	4
(f) Tubercle of kidneys	...	...	...	...	...	1
(g) Tubercular meningitis	...	...	...	...	...	2
(h) Tubercular pericarditis	...	...	...	...	...	2
(i) Tubercular peritonitis	...	...	...	...	...	2
Cholera	...	...	...	...	...	143
Malaria	...	...	...	...	...	104
Beri-beri	...	...	...	...	...	93
Pneumonia (lobar)	...	...	...	...	...	54
Enteric fever	...	...	...	...	...	42
Morbus cordis	...	...	...	...	...	50
Phagedænic ulceration and sapræmia	...	...	...	...	...	29
Cirrhosis of liver	...	...	...	...	...	23
Malignant disease, carcinoma, &c.	...	...	...	...	...	18
General debility and senile decay	...	...	...	...	...	17
Colitis	...	...	...	...	...	15
Endocarditis (ulcerative)	...	...	...	...	...	14
Enteritis	...	...	...	...	...	11
Suspected poisoning	...	...	...	...	...	11
Plague	...	...	...	...	...	10
Injuries to skull, meninges, &c.	...	...	...	...	...	10
Rupture of spleen	...	...	...	...	...	9
Enterocolitis	...	...	...	...	...	8
Chronic interstitial nephritis	...	...	...	...	...	7
Fractures of limbs, &c.	...	...	...	...	...	7
Acute cellulitis	...	...	...	...	...	6
Suppurative peritonitis	...	...	...	...	...	6
Gangrene of lungs	...	...	...	...	...	6
Suffocation	...	...	...	...	...	6
Stabbing	...	...	...	...	...	5
Pneumonia (catarrhal)	...	...	...	...	...	5
Aneurism of aorta	...	...	...	...	...	5

Cerebral softening	...	...	...	4
Cerebral hæmorrhage	...	...	...	4
Suppurative meningitis	...	...	...	4
Pleurisy	...	...	...	4
Septicæmia	...	...	...	4
Syphilis	...	...	...	4
Empyema	...	...	...	3
Pyclonephritis and cystitis	...	...	...	3
Cut throat	...	...	...	3
Abscess of lung	...	...	...	2
Cholelithiasis	...	...	...	2
Necrosis of bones	...	...	...	2
Pneumonia septic	...	...	...	2
Strangulated hernia	...	...	...	2
Apoplexy (heat)	...	...	...	2
Burning	...	...	...	2
Cystic degeneration of kidneys	...	...	...	2
Cerebral abscess	...	...	...	2
Cancrum oris	...	...	...	2
Dislocation of spine	...	...	...	2
Appendicitis	...	...	...	1
Fibrosis of lung	...	...	...	1
Myelitis (spinal)	...	...	...	1
Nephritis (acute)	...	...	...	1
Acute intestinal obstruction	...	...	...	1
Paraplegia (traumatic)	...	...	...	1
Pyosalpingitis	...	...	...	1
Gastric ulcer	...	...	...	1
Abscess of kidney	...	...	...	1
Suppurative arthritis	...	...	...	1
Splenomegaly	...	...	...	1
Pericarditis (suppurative)	...	...	...	1
Arteriosclerosis	...	...	...	1
Ischiorectal abscess	...	...	...	1
Gumma of spinal cord	...	...	...	1
Osteomyelitis acute	...	...	...	1
Tetanus	...	...	...	1
Otitis media	...	...	...	1
Perityphlitis	...	...	...	1
Perisplenic abscess	...	...	...	1

R. D. KEITH,
Acting Government Pathologist.

No. 10 in Appendix VII.

TRINIDAD.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received February 4, 1907.)

MY LORD,

Government House, January 19, 1907.

I HAVE the honour to acknowledge the receipt of your Lordship's despatch, General, of the 6th ultimo,* asking to be furnished with six-monthly reports of the work of research in tropical diseases, carried out in the Government laboratory of this Colony.

2. The Medical Officer of Health informs me, that owing to want of the proper equipment it has not been possible to do any research work hitherto, his efforts being limited to diagnostic work, and that he is not, therefore, in a position to furnish the required returns.

* Not printed.



3. Provision has, however, been inserted in the draft estimates for 1907-8 for the purchase of equipment, and your Lordship's wishes will be borne in mind as soon as it become practicable to give effect to them.

I have, &c.,
H. M. JACKSON,
Governor.

No. 11 in Appendix VII.

EAST AFRICA PROTECTORATE.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received June 26, 1907.)

MY LORD,

Governor's Office, Nairobi, May 28, 1907.

I HAVE the honour to transmit herewith the half yearly report of the Government bacteriologist for the six months ending March 31st, 1907, together with the Principal Medical Officer's covering letter.

3. I am taking steps to act on Colonel Will's suggestions regarding the employment of Kavirondo labour, and I am instructing the manager of the railway not to use these natives on the line east of Nairobi.

I have, &c.,
J. HAYES SADLER.

Enclosure 1 in No. 11 in Appendix VII.

LABORATORY REPORT.

Nairobi, October 1, 1906, to March 31, 1907.

During the past six months there has been a considerable increase in the work of the laboratory. In all 469 examinations were made, most of them of blood smears. The arrival of the veterinary bacteriologist during the month of December made it possible to keep pace with the work, and there will probably be a much larger increase in the work during the next half-year. Up till now the accommodation has been cramped, and experimental animals difficult—often impossible—to obtain. Work has, therefore, been very largely confined to microscopical examinations, but, as the results of these have determined to a great extent what diseases are present in the country, we should now be able to make the best use of the increased facilities afforded by the provision of the new laboratory. Apart from the routine examinations, the number of which varies as material is sent in, there will be considerable work attached to the preparation of vaccine lymph and pleuropneumonia virus. Further experiments with the various tsetse flies are urgently required to determine whether or no they are able to transmit the *Trypanosoma gambiense*; the one successful experiment with *Glossina fusca* being sufficient to make one extremely anxious on this point. A glance at the accompanying "fly map" will show to what a large extent the Protectorate would suffer (should these flies be capable of conveying the disease) if cases were to find their way into the various fly belts. For example, Voi is the centre of the promising fibre industry, and Fort Hall, five miles from which *Glossina fusca longipennis* and *pallidipes* have all been found, is the centre of the most densely populated Kikuyu country. The danger is probably greatest along the railway zone and may be said to extend from Mombasa to Athi River, a mile from which latter station *Glossina pallidipes* have been caught.

The discovery of enteric fever in the country has made it possible to get stock cultures of the bacillus, and so carry out Widal's reaction. On the veterinary side the whole question of the Russian fever of cattle of Dschunkowsky requires to be settled if possible, and there are probably two new diseases to be worked at, that referred to in previous reports as M'Kebbe among calves and a disease in the dog referred to elsewhere.

Recently quite a number of tumours have been sent in for examination, but the work on these is not yet complete. It may be mentioned here, however, that, so far, several sarcomata have been met with.

The discovery of minerals in the Protectorate has brought to the laboratory a good deal of work which cannot be called bacteriological; for the lack of a chemist

has resulted in many mineral samples being sent to the laboratory for analysis. Work which to a professed chemist would be simple and straightforward becomes difficult and tedious for anyone unaccustomed to it.

Our best thanks are due to Professor Nuttall for his kindness in classifying the various ticks and flies sent to him. The results are still too incomplete for inclusion in this report.

Malaria.

Fifteen blood smears have been sent for examination. Of these, five showed pigment and relative increase of the large mononuclear leucocytes, and, of the others, one showed benign tertian, three quartan, and six subtertian parasites.

Tubercle.

Material from three cases was sent for examination and the tubercle bacilli were found. In two cases the material was sputum, and in the third it came from a case of acute general tuberculosis.

Trypanosoma and Filaria in a Bird.

Recently, in a blood smear taken from a bird (*Bycanistes cristatus*) shot at Kibwezi, both trypanosomata and filaria were found. Measurements of series of these are given below, and it is hoped that drawings and microphotographs will be available for the next half-annual report.

Filaria.

75 μ $\times$ 4 μ
60 μ $\times$ 4 μ
78 μ $\times$ 5 μ

Trypanosoma.

25 μ $\times$ 9 μ
27 μ $\times$ 9 μ
20 μ $\times$ 6 μ
26 μ $\times$ 9 μ
33 μ $\times$ 6 μ
35 μ $\times$ 6 μ
35 μ $\times$ 7 μ
33 μ $\times$ 8 μ

Spirillosis.

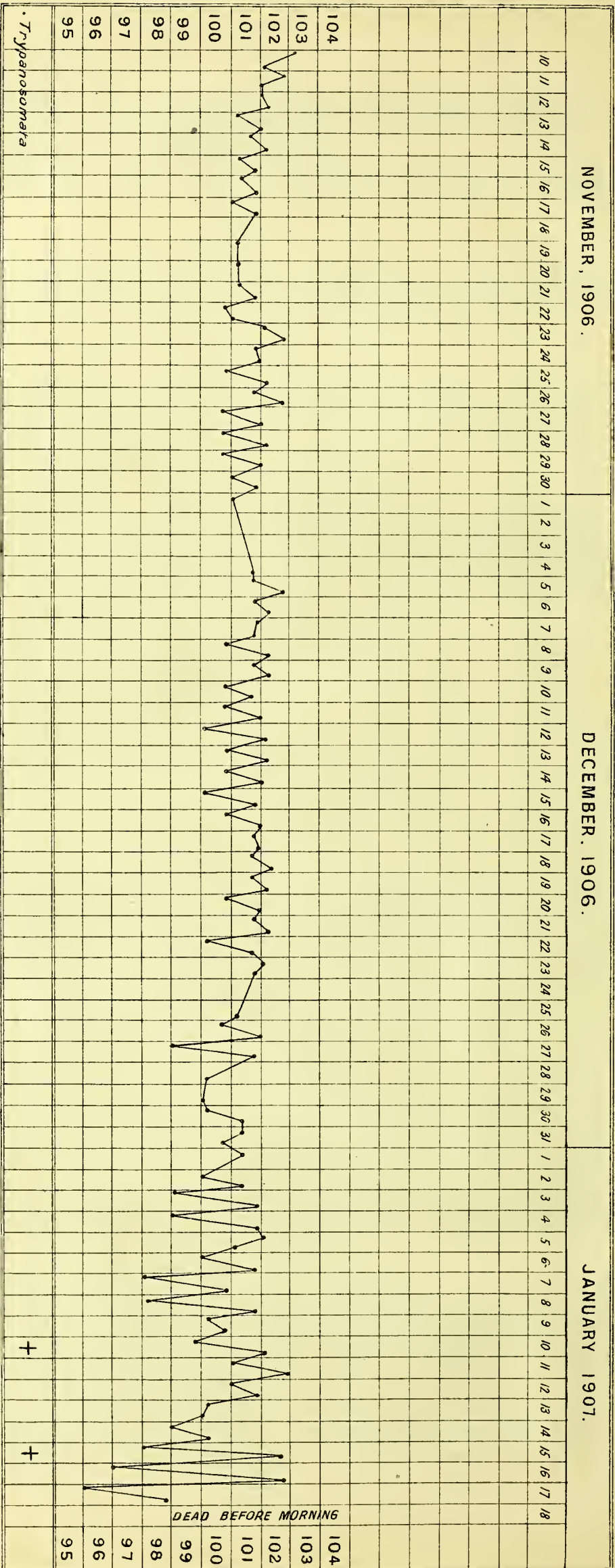
Spirillosis hominis.—One imported case of tick fever—contracted in Uganda—has been seen. There has also been an exceedingly puzzling case in a native brought moribund to the Civil Hospital. Dr. Haran carried out a post-mortem examination, and smears of liver, spleen, and heart's blood showed swarms of spirochætæ. The man had been in Uganda six years before, but had spent four years in the Kenya district and the last two years in the Nairobi district. So far, the disease has never been met with in these highlands nor has the ornithodoros been found. Did the disease exist here one would certainly expect to have met with it in some European or Indian in whom the symptoms are severe and the parasites usually easily found, even though there had been failure to diagnose it in the native. But this case places us between the two alternatives (1) that the disease exists here, and (2) that the dead man had contracted the disease in Uganda six years ago. But although it is well known that the spirochætæ may persist in the body and give rise to some symptom such as iritis many months after the patient thinks the disease has been shaken off, one can hardly believe that the parasite could persist in the body for six years and then cause the death of the patient from acute spirillosis.

Spirillosis Bovis.

Spirochætæ have been found in three cattle. The first case was a cow at Limoru, which, in spite of a raised temperature, seemed in the best of health. The second case was one of the imported inoculated Devons referred to elsewhere, and the third case was a cow bought locally with a view to infecting it with both spirillosis and piroplasmosis from the imported Devon.

The spirochæta is rather small—14 μ to 20 μ —and, so far as seen, does not seem to bring about any ill results. In this it resembles the *Sp. bovis* of South Africa and differs from the *Sp. equi*, a fatal case of infection which was recently

MONKEY N^o. 83.



Nov. 10 inoculated 2 c.c. blood from Dr. Haran's case. (Guinese)

Parasites found 61 days after inoculation.
Temperature atypical till last days.
Death on 70th day from inoculation.

P. M. changes as usual in Trypanosomiasis (v Gambiense).

described by Mr. Stordy. No further cases of spirillosis in the horse have been met with.

NOTE.—Since the above was written, Mr. Perceval, the game ranger, has found the *Ornithodoros moubata* in the Kedong Valley. The case of *Spirillosis hominis* is therefore explained, but this discovery makes it more difficult to understand why cases of the disease have not been met with in Indians and Europeans.

Trypanosomiasis.

Trypanosomiasis hominis.—Two cases of trypanosomiasis have come under observation—one in a Goanese who had contracted the disease at Jinja, and the other in an Indian who had been working at Kisumu. In neither case has the disease followed a typical course. If ever there was a case where the prognosis was one of early death, it was that of the Goanese, but under Dr. Haran's treatment, first with arsenic and then, when it became available, with atoxyl, the glandular swelling which was enormous has practically disappeared and with it the other symptoms both subjective and objective. An interesting point in connection with this case is the behaviour of the disease in the monkey which was inoculated from the patient's blood. The temperature chart of this animal (*q. v.*) shows the extraordinary long incubation period before parasites could be found or the temperature rose, and the rapid course of the disease to death when once the parasites had appeared in the blood. The latter point is not so remarkable as the former for the only monkey available for the experiment was a Sykes' cercopithecus, a monkey which out here seldom lives long in captivity. The second case—that of the Indian—was chiefly of interest as emphasizing the danger which may exist in the movement of labour from sleeping sickness areas to other fly belts. There are already legal restrictions on such movement, but, in spite of this, Kavirondo and Baganda can be found working at practically any place between the lake and Mombasa. West of the Athi River along the railway zone the matter is one of little or no importance, but in such a place as Voi introduction of the disease would mean the ruin of the fibre industry.

Experiments in transmitting the disease with the various tsetse flies are still at a standstill from lack of suitable animals, but the one positive result with the interrupted feeding of *Glossina fusca* is exceedingly disquieting.

The annexed map shows as far as is now known the distribution of the various tsetse flies throughout the Protectorate. Where a fly is definitely stated to occur, specimens of fly from that place have been examined. Where a locality is marked with a cross it means that tsetse fly have been reported by good observers, but specimens have not been examined.

Trypanosomiasis of Animals.

Blood smears showing trypanosomata have been received from Taveta and Fort Hall. In the former case the smears came from donkeys and cattle, and there seems to have been a heavy mortality among the animals from the disease on the road between Voi and Taveta. The case at Fort Hall was in a mule, and the disease was probably contracted on the Thica or Tana River. Two cases were also seen in imported Indian cattle on a farm inside the Nairobi quarantine area. In these cases the disease had probably been contracted either at Mombasa or on the Uganda Railway. At Mombasa there would seem to have been some recent extension of the fly belt, for *Glossina pallidipes* has been found quite close to the local quarantine station at Mombasa. Knowing this, the local veterinary officer, in the cases in question, had kept the two cows and their calves in the pound. This is well in the middle of the island and should be quite free from fly. But the animals were sent to Nairobi in a covered goods waggon with the top of one door open for ventilation. I have myself caught all three tsetse flies (*Glossina pallidipes*, *Glossina fusca* and *Glossina longipennis*) in a carriage on the railway between Mombasa and Makindu, so that one can by no means exclude the possibility of the animals having been infected while in the truck. The fact that the calves escaped infection rather supports this supposition, as an odd fly or two, coming into the truck, would certainly meet the large animals first, whereas in Mombasa probably all would have been infected. In the two infected animals the disease ran a very rapid course, and a rather unusual condition noticed was hæmorrhage into the anterior chamber of the eye. These two animals suffered from a complication, in that they contracted

East Coast fever; but death ensued before the infection of corpuscles with *Piroplasma parvum* had reached a high percentage.

Plague.

No case of plague has occurred in Nairobi, but a death was reported on one of the lake steamers. It was also reported that dead rats had been found in the store room of this steamer some days before the illness was reported, and the man who died was the one who had to go most often to the store.

When the steamer returned to Kisumu she was anchored out in the bay, and cargo, all in sacks, discharged into a lighter. The whole ship was then thoroughly cleaned, bilges cleaned out, holds washed out and lime-washed, and finally disinfected with Clayton gas. No dead rats were found, but between two and three hundred live ones were caught and killed. Over 60 of these were sent ashore and examined, but no infected ones were found. The measures taken seem to have been sufficient as no further cases have occurred on the ships nor has any case been discovered at Kisumu, although cases are reported from German territory.

On vessels trading on the Victoria Nyanza, round whose shores plague would seem to be endemic, some regular system of dealing with rats would probably help greatly in preventing the spread of the disease. Thus rat traps should be carried on all ships, including dhows, and should be set every night. If the rats become too cunning for the traps, poison could be laid with proper precautions. Thorough cleaning out and lime-washing of the holds at frequent intervals would result in two benefits; in the first place rats which had escaped traps or poison would be killed and they would be unable any more to nest among old dunnage; and in the second place the bilge could be cleaned out and oil spread. As pointed out by Dr. Andrew Balfour, the bilge water is a favourite breeding place for various mosquitoes, whose larvæ hatch out in the bilge, while the resulting imagines soon find their way over the ship. Still another benefit would result, which though perhaps not epidemiologically important, would be much appreciated by the passengers, namely, a considerable diminution in the number of cockroaches.

From Mbale (Uganda) one slide was received for examination. This slide was a smear made from a bubo and was found to contain a pure culture of a bi-polar staining bacterium. As I know of no condition in man except plague in which such organisms would be found in a gland, I am of opinion that this slide must have been taken from a case of plague. Under these circumstances the disease must exist in the Uganda Protectorate and can no longer be regarded as confined to the east and south shores of the Victoria Nyanza.

Typhoid Fever.

Post mortem examinations were made by Dr. Haran on two cases at the native hospital and typical typhoid lesions were found. From the spleen of each case an organism was isolated in pure culture, which organism had all the morphological and staining characteristics of the bacillus typhosus. Grown on agar, gelatine, milk, neutral red and litmus media, the growth resembled in every particular the growth of the bacillus typhosus. It can hardly be doubted that typhoid fever is now present in the country if it were not here before—and reports as to its presence or absence are exceedingly contradictory—it has presumably been imported by the many South Africans who have come here in the last three years. So far no case has been reported among Europeans. Fortunately the Nairobi water supply is above suspicion, but the knowledge that the disease is here should make people in out-districts, if possible, additionally careful as to the boiling and filtering of their drinking water.

Water Analysis.

During the last six months chemical analyses have been carried out on seventeen samples of water forwarded from various parts of the Protectorate. The results of these analyses, taken with results of previous examinations, give sufficient data from which conclusions may be drawn with a reasonable prospect of such conclusions being correct. In a few cases where the water has been drawn direct from a spring, the sample has shown a good potable water which should remain up to sample, provided that the necessary precautions be taken to prevent pollution of the source. At the opposite extreme from these waters are the waters, samples of which have shown evident signs of sewage pollution. These samples have come

from rivers and lakes, and the very nature of the local conditions would make it surprising if the samples did not show signs of pollution. One sample, for example, was labelled as having been taken "from the Njoro stream south of and immediately below the Syndicate farm buildings." In such a case the sample might almost be considered as damned by its label and hardly worth the time and trouble necessary for the chemical analysis, which ultimately proved the extreme accuracy of that label. In another case—that of the Kisumu water supply—ocular demonstration has since confirmed the conclusions arrived at by the analysis. For when the S.S. "Winifred" was quarantined off the Kisumu pier, and old dunnage, ship's refuse, and various other forms of filth were thrown overboard, they could clearly be seen to be blown by the morning lake breeze immediately over the intake pipe of the town supply. But apart from such extreme cases, every river and lake in the Protectorate must be liable to fouling by the game, and where there is any native population pollution with the excreta of these natives is almost certain to occur. A given sample of such water may happen to be pure enough to pass the tests imposed on it, but such purity can only be regarded as an accident and an accident which cannot be expected to recur. Any water, therefore, except those spring waters mentioned above, must be regarded with the gravest suspicion and should not be used as a source of private supply without boiling or filtering, nor of public supply without proper filtration. Those people, and they are not few in this country, who regard boiling and filtering as a useless refinement, may possibly be encouraged to adopt one if not both of these measures by the knowledge that enteric fever is present in the country.

In the veterinary section of the laboratory during the six months ending March 31st, 290 specimens have been reported upon both macroscopically and microscopically, but chiefly the latter. Of these, 157 have been negative and the remainder have been classified under the heads of the following diseased conditions:—

Piroplasmosis.

(A) *Canine*.—Seventeen blood smears contained the *Piroplasma canis* in a more or less marked degree. The duration and course of the disease in those cases in which it was possible to follow them showed the period of illness in cases of recovery to be from one to three months, and in fatal cases death usually took place within a week, the period varying according to the severity of the attack, and the constitution of the animal affected. Freshly imported dogs were the worst sufferers, and the mongrel and stray dog of the country showed the highest percentage of recoveries. In the case of imported animals convalescence and recovery are protracted, the disease leaving the animal in a state of anæmia and weakness. In these dogs relapse is common and usually fatal, and is often complicated with marked ascites. Drugs appear to be useless and even the most carefully nursed cases seldom recover.

The bacteriology of this affection has been discussed in previous reports from the laboratory, and at present there is nothing further to add to it.

The post mortem symptoms are not always constant, in many cases the characteristic icteric conditions were present in the mucous membranes, liver and kidneys, but in others this was replaced by an anæmic and pallid condition. The enlargement of the spleen was an almost constant symptom. The constant presence of the *H. Leachii* in the various districts of the Protectorate, acting as the medium of infection, at present precludes the possibility of a probable decrease in outbreaks, and, so far, no effective method of establishing an immunity against this disease has been devised.

(B) *Equine*.—Three blood smears contained the *Piroplasma equi*, all of which were from one case in Nairobi. The duration of illness was three weeks, and complete recovery took place. The piroplasmata were numerous, and the horse showed the typical icteric mucous membranes with petechial spots and prostration with the passage of red and, later, coffee-coloured urine. The corpuscular infection was a high one, and several infected corpuscles showed cruciform parasites. Other blood smears from horses, the history of which suggested piroplasmosis, have been examined with negative results. At the present time experiments are being carried out on a large scale in the Transvaal Bacteriological Laboratory with a view to the production of an immunity against equine piroplasmosis. So far the immunity thus produced has been a mild one, but hopes are entertained that at a

later date an effective use may be made of it, in which case, no doubt, where circumstances warrant it, the possibility of its use in this Protectorate might be entertained, but so far only a few cases have been met with.

(c) *Bovine*.—(a) *Piroplasma bigeminum*.—Four smears of simple red water have been examined which showed no complications. They were in pure and half bred stock. One was in an imported shorthorn bull that had been in the country and the Kyambu district two years before becoming infected. This bull had a very high per cent. of infected corpuscles, but recovered from the attack in about ten days. An experiment with previously immunised imported animals is being conducted at present, the result of which will be communicated later.

(b) *Piroplasma parvum*.—Twenty slides were examined showing the piroplasma of East Coast fever without complications. These specimens were received from native, half-bred, and pure-bred animals.

The progress of the disease in Nairobi area has been slow. This might be accounted for by the comparatively small number of bovines in the area and the large number of other animals on which infected ticks might cleanse themselves.

Until within a few weeks, the cases that came under the notice in the laboratory occurred within the quarantine area, but since that date an outbreak has been reported from a few miles outside the quarantine area. The post mortem examination showed the characteristic lesions of East Coast fever, and microscopical examination of smears of organs has demonstrated the invariable presence of the characteristic blue bodies described by Koch and in previous reports from this laboratory.

(c) *Mixed Piroplasmic Infections*.—Six slides on examination showed a mixed infection of *Piroplasma parvum* and *Piroplasma bigeminum*, probably due to the breakdown of redwater immunity consequent upon an attack of East Coast fever; and, in two cases, East Coast fever was complicated with trypanosomiasis.

(d) *Piroplasmata other than the preceding*.—Until quite recently tropical bovine piroplasmosis included *Piroplasma parvum* and *bigeminum*: at the Buda Pesth Conference in 1903, however, Dschunkowsky described a piroplasma, simulating the *parvum* in many details but differing clinically and in mortality in outbreaks, which parasite he called the piroplasma of trans-Caucasian fever—a new species. Theiler, in the Transvaal, up to as recently as twelve months ago, had accepted the presence of ring and red piroplasmata following an attack of redwater as the immune form of that disease. Recently, however, Theiler, as a result of an exhaustive series of experiments, has convinced himself that what he previously accepted as the piroplasmata of immune redwater are really the piroplasmata of a separate diseased condition, and he has named his new species the *Piroplasma mutans*. Up to now, however, he has not been able to transmit the piroplasma except as a sequel to redwater. Placing the *P. bigeminum* on one side as an undoubtedly distinct species and accepting Theiler's piroplasma as a new species, we are now faced with three different species of piroplasmata, all bearing a distinct resemblance to one another, viz., *P. parvum*, so-called Russian, and *P. mutans*. Undoubted cases have occurred in the Protectorate of animals showing piroplasmata in their blood which in many ways resembled those described by Theiler and which, up to now, have been accepted as evidence of the later stages of redwater, and we hope to be able to follow up the question in experimental animals. Koch has described Dschunkowsky's disease in German East Africa, and we have reason to suppose that we have observed cases similar to those described by him. The whole question is one that will require exhaustive experiments before any conclusion can be arrived at.

(2) *Blood Changes.*

Twelve slides on examination showed marked alteration in the shape and staining character of the corpuscles which indicate the late or convalescent stage of piroplasmosis.

(3) *Trypanosomiasis.*

This affection is dealt with in connection with human trypanosomiasis.

(4) *Strongylosis.*

Ovine strongylosis, both bronchial and gastric, is apparently a widespread affection in the Protectorate, and from information received it is a serious factor in the successful raising of young stock. The specimens obtained from dead animals have been contortus and convolutus, and a species which has been classified as cervicornis, and the *strongylus filaria*.

Another sheep affection which is fairly widespread is due to the presence of *Oestrus ovis*, whilst although not a uniformly fatal affection it seriously affects the condition of the infected animals. So far, it has not been possible to successfully hatch out the larvæ for the purpose of ascertaining the fly responsible for its deposition, but arrangements have been made by which larvæ freshly blown out from the nostril will be forwarded to the laboratory for this purpose.

(5) *Horse Sickness.*

Only one case of horse sickness was diagnosed, but the period over which this report extends does not include the horse sickness season. So far, the experiments carried on by the bacteriological laboratory in the Transvaal have not proved the efficacy of an immunisation suitable for horses, although success has attended the preventive inoculation in mules. The drawback so far has been the difficulty in ascertaining the different degrees of intensity of the virus in various districts, but this to a great extent now has been overcome. This will probably be the difficulty in the Protectorate, and it will be necessary to test the virulence of the blood in the different districts before proceeding further in the matter. This can be done by submitting samples to Dr. Theiler at the Pretoria Laboratory, who has kindly undertaken to test them and report the result. In any case, if it is desired, immunised mules could be obtained at Pretoria, and it would be interesting to ascertain if the immunity against the South African strain of virus is efficient for this Protectorate. When this has been determined the advisability of preventive inoculation on a large scale could be entertained.

(6) *Cryptococcus of Rivolta (Epizootic Lymphangitis).*

Two specimens submitted for examination showed the presence of the typical organism of this disease.

(7) *Helminthiasis.*

Several specimens of parasites have been obtained, principally the gastric and bronchial filaria from sheep. In one instance the post mortem on a wild zebra revealed the presence of an enormous quantity of parasites in the stomach and bowels, which parasites are identical with those found in the horse, viz., *Sclerestoma armatum*, *Sclerestoma tetracanthum*, *Oxyuris curvula*, and the abdominal *Filaria equina*. In the stomach were found immense quantities of larvæ, which were probably the *Oestrus equi*, but attempts to hatch them out and ascertain the fly responsible for their production have failed. The presence of these parasites apparently had no deleterious effect on the animal, which was in good condition.

The *Sclerestoma tetracanthum* and *Sclerestoma armatum* are directly responsible for the production of parasitic enteritis and verminous aneurism, and, taking into consideration the enormous number of zebra in the Protectorate and their wide distribution, the fact of their harbouring these parasites must be looked upon as a serious factor to be reckoned with in the successful raising of horse stock. Larvæ have also been obtained from the intestine of rhinoceros, but, like the preceding, have so far failed to hatch out.

(8) *Pneumonia.*

(A) *Simple.*—Six specimens of lung sent were affected with simple pneumonia, viz., pig 3, ox 1, sheep 1, and chicken 1.

(B) *Contagious Bovine Pleuro-Pneumonia.*—The lung of one calf was the only specimen which showed contagious pleuro-pneumonia. It is hoped in a short time when satisfactory arrangements have been completed, that we may be in a position to produce a virus in the laboratory which will supersede the present method of preventive inoculation now in use. In this case we shall have a stock of virus in

hand which can be sent out for use as required, and there will be no necessity to wait for an affected animal before the inoculation can be carried out.

(c) *Pleuro-Pneumonia of Goats*.—This affection apparently has a wide distribution in the Protectorate and is responsible for a high mortality in stock. Unlike the preceding bovine affection no known method of preventive inoculation has yet been devised, in fact, attempts to produce the disease experimentally have failed. Microscopical examination of the spleen of animals dead of this affection has shown in some cases the presence of extra corpuscular blue staining circular bodies with chromatin particles, but up to now we have not been able to associate these as in any way causal in connection with the disease.

(9) *Dog Disease*.

An imported dog in quarantine at Nairobi suffered from an illness simulating canine tick fever, but microscopical examination of the blood failed to reveal the presence of the *Piroplasma canis*. This dog died after an illness of three weeks' duration. During the latter part of the illness blue bodies were observed microscopically, which bodies contained chromatin staining particles.

Experimental inoculation of blood from this affected animal into an apparently healthy dog has up to the present not produced a definitely similar condition, but, unfortunately, the experimental dog contracted canine piroplasmiasis, from which he is recovering. The affected dog had only been in the country a few days and had not suffered from piroplasmiasis. Whether this disease is a form of canine piroplasmiasis or not we have not yet determined, but in a later report we shall hope to be able to produce more information on the subject. A case had occurred a short time previously which showed similar symptoms during life, and post-mortem changes and similar blue bodies, on microscopical examination, together with enlargement of the spleen.

(10) *M'Kebbe*.

A disease affecting calves has been observed amongst natives and half-bred stock which has been called by the natives by this name. Reference has been made to it in a previous report, and as soon as circumstances permit experiment will be carried out in connection with it.

(11) *Avian Diphtheria*.

One case of avian diphtheria occurred in an imported game cock. The animal died, and the disease was experimentally transmitted with cultures of the organism to a susceptible fowl with fatal result.

(12) *Black Quarter*.

Two slides, on microscopical examination, showed an organism morphologically indistinguishable from that of black quarter from muscle smear of an affected animal in the Machakos District. This is the only case that has been observed in the laboratory.

(13) *Acariasis*.

Only one case of acariasis has been reported upon, which occurred in a horse in the Nairobi District.

(14) *Spirillosis Bovis*.

This is discussed under the heading of human spirillosis.

In addition to the reports made on the above-mentioned diseases, considerable time has been taken up in the classification and mounting of the various ticks and flies. A number of specimens have been received for classification, and in those cases where they could not be relegated to their various genera here, duplicate specimens have been sent to England with a view to ascertaining their correct species.

The tick plays such an important role in the dissemination of disease in the Protectorate that it is absolutely essential that the fullest data should be obtained regarding its habits and complete life history both on and off the animal body. The habits of the common varieties such as the *decoloratus*, *appendiculatus* and *Evertsi* have been thoroughly worked out and it has been proved with certainty that they

Spirillosis, bovis	...	...	...	...	...	...	...	...	3
Cryptococcus of ravalta	...	...	...	...	...	...	...	...	3
Helminthiasis	...	...	...	...	...	...	...	...	3
Tumours	...	...	...	...	...	...	...	...	2
New disease in dogs	...	...	...	...	...	...	...	...	7

PHILIP H. ROSS.
HENRY G. SIMPSON.

Enclosure 2 in No. 11 in Appendix VII.

SIR,

Principal Medical Officer's Office, Nairobi, May 28, 1907.

I HAVE the honour to submit, for the information of His Excellency the Governor and transmission to the Secretary of State, in compliance with Colonial Office general despatch of December 6th, 1906, the first half-yearly report of the Government Bacteriologist.

There are three subjects dealt with in the report to which I would draw special attention, viz., the distribution of tsetse fly and the probable danger of spreading sleeping sickness in East Africa should this disease be introduced into the fly areas, the certain occurrence of enteric fever, and the probable existence of spirillum fever in East Africa.

1. *Tsetse fly*—*Glossina palpalis*—is found along the shores of the Victoria Nyanza and the rivers running into it, and sleeping sickness is co-existent with it.

On the Athi River, 18 miles east of Nairobi, *G. pallipides* is found, and, as may be seen from the map submitted by Dr. Ross, *G. fusca*, *G. longipennis*, and *G. pallipides* exist in patches along the Uganda Railway to Mombasa, as well as on the tributaries of the Thika River in Kenya Province.

During the past two years Dr. Ross has been carrying out a series of experiments with the object of ascertaining whether the trypanosomæ of sleeping sickness can be conveyed by other species of glossinæ than the *G. palpalis*, and in 1905 succeeded in transferring the *Trypanosoma gambiense* (T. of sleeping sickness) from an infected monkey to an uninfected one. In carrying out his experiments he has had great difficulty in procuring suitable monkeys, the majority of whom suffer from piroplasmosis and die readily from this disease when kept in captivity. As it is of vital importance to know if there is any danger of the other species spreading sleeping sickness should it be introduced into the areas where they exist, these experiments are being continued.

To obviate as far as possible sleeping sickness being introduced into the eastern provinces of East Africa, rules were introduced in 1904 with the object of preventing natives of Uganda and Kavirondo travelling in an easterly direction beyond 25 miles from the Victoria Nyanza. Very few Buganda come into East Africa—the few who do settle at Kisumu, and to this there is no objection. But the natives of Kavirondo have evaded these rules and have come in numbers as far as Nairobi seeking work, in fact, at the beginning of the current year the rules had practically become a dead letter and fresh rules had to be drafted. Having regard to the existence of famine in Kavirondo, it was necessary to extend the eastern limit to give greater facilities to the Wakavirondo to obtain employment, and I suggested Nairobi being the limit beyond which they would not be permitted to travel by rail, but at the request of the Manager, Uganda Railway, extended the limit to Machakos Road so as to give employment on the railway to as many Wakavirondo as possible, who, at the time, were suffering from scarcity of food.

The threatened famine in Kavirondo has now been tided over, and although Machakos Road and the stations between it and Nairobi are free from fly, I consider it would be safer to make Nairobi the eastern limit as I originally suggested. This should not interfere seriously with the labour supply for the railway, there being the thickly populated Kikuyu country to draw on.

To guard against the threatened danger of sleeping sickness being introduced into the eastern provinces the following procedure is carried out, viz., medical inspection at Kisumu, police check at Nakuru, and again at Nairobi.

2. *Enteric Fever*.—Authentic cases of this disease have been reported during the past six months for the first time. It may, as Dr. Ross suggests, have been

introduced by some of the numerous settlers arriving from South Africa, but up to date I am not aware that any European has suffered from it. With the exception of Nairobi, the water supplies throughout the Protectorate are extremely liable to pollution, and the danger of this disease becoming epidemic is very obvious.

3. *Spirillum Fever*.—One case of this affection is reported and the infection appears to have been contracted in East Africa where, hitherto, the disease has been unknown.

Since Dr. Ross's report was written the tick (*Ornithodoros moubata*) which conveys the spirillum has been found in numbers in the Ngong Valley.

Experiments are being conducted with the object of ascertaining if these ticks are infected or not.

I have, &c.,
J. WILL,
Principal Medical Officer.

The Secretary
to the Administration,
Nairobi.

No. 12 in Appendix VII.

EAST AFRICA PROTECTORATE.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received December 14, 1907.)

MY LORD,

Governor's Office, Nairobi, November 8, 1907.

WITH reference to my despatch of May 28th,* I have the honour to transmit herewith the report of the Government Bacteriologist for the six months ending September 30th, 1907, together with the Principal Medical Officer's covering letter.

I have, &c.,
J. HAYES SADLER.

Enclosure 1 in No. 12 of Appendix VII.

NAIROBI LABORATORY REPORT.

April 1st to September 30th, 1907.

During the past six months a most important change has been made in the work of the laboratory by the removal on June 5th into the new building. The extra space, the water supply and the coolness of the new building are all important, and the difference in temperature is shown by the fact that gelatine media can now be used, whereas in all the temporary buildings hitherto occupied such media could never be kept solid.

The general medical work of the laboratory has considerably increased, many more specimens having been sent for examination than in previous six months. But the opportunities afforded by the new building for work which could not have been attempted under previous conditions have emphasized the disadvantage caused by lack of experimental animals. Guinea pigs and rabbits have been imported from Zanzibar, and, since the removal into the new quarters, have been kept under the best possible conditions. But in spite of this, guinea pigs have died, and those left do not breed, and the rabbits have aborted, so that it seems as if it would take some time to get any supply of either. As regards monkeys, the local ones "*Sykes' Cercopithecus*," when kept in captivity have rarely done well; most of them die of piroplasmiasis soon after arrival and are therefore useless for experiments—as with tsetse fly—which are spread over any length of time. The best monkey for the purpose is the small grey monkey which is found near Fort Hall; but, so far, oft-repeated requests for these monkeys have failed to produce even one. On the arrival of the vaccine plant the preparation of lymph was immediately begun. So far 800 tubes—sufficient for over 2,000 vaccinations—have been produced. No

* No. 11 in Appendix VII.

figures are available as to the proportion of successful vaccination with this lymph, but so far as known the percentage of successful has been very high. The amount produced will now depend entirely on the demand.

Owing to lack of animals it has not been possible to carry on the experiments on transmission of the *Trypanosoma Gambiense* by the various tsetse flies, so that the supply of flies has been used as material in research into their intestinal parasites. Although not complete, the results so far have been to confirm, in *Glossina fusca*, the observations of Gray, Tulloch and Novy on the *Glossina palpalis*. This makes it more difficult than before to determine whether the *Glossina* is a simple vector or an actual host of the various trypanosomata. For even if there be a developmental stage of the trypanosoma in the fly, the presence of two or three non-pathogenic trypanosomata, as almost constant and natural inhabitants of the gut of the tsetse, makes it appear almost hopeless to follow the changes in the parasite taken up by the fly from an infected animal.

Blood Examinations—Malaria.

The number of blood smears sent for examination has considerably increased. During the past four months a practice has been made of carrying out a differential leucocyte count on every slide in which parasite could not be found. The information thus gained must often be valuable, and is apparently considered so by the senders of the specimens, if one is to judge by the number of slides which have arrived with a request for such a count, if the examination is otherwise negative. In all, 212 specimens have been sent in. Of these 88 are recorded as negative, these including various smears of body fluids and blood smears which were either too bad for any count to be made or were sent in before the practice of making such counts had been decided on. But 92 leucocyte counts were made, and in 32 the presence of pigmented large mononuclear leucocytes was also noticed, so that a very large number of the slides sent evidently came from cases of malaria. Of the slides which actually showed malarial parasites, 17 contained tropical ring forms, one benign tertian and 10 quartan parasites. Besides these there were four mixed infectious, one tropical and benign tertian, one tropical and quartan and two benign tertian and quartan malaria.

Most of these specimens came from natives or Indians, very few being from white men. The parasites are usually scanty and hard to find, and only in two cases have crescent forms been seen.

Along the banks of the Nairobi River the number of mosquitoes has certainly diminished very much. This is chiefly due to the gradual increase of cultivation with consequent destruction of the papyrus swamp. These changes, coupled with a long period of dry weather, have resulted in places where one was accustomed to go for mosquito larvæ being now quite dry. In fact, several hunts for larvæ along the river have failed to produce a single larva. The condition of Nairobi as regards mosquitoes seems to have very much improved. Complaints as to their presence have usually been confined to single houses, and search has shown that there was a forgotten borrowpit in the neighbourhood, and its filling up or draining has soon removed the trouble.

One smear from a spleen puncture was sent from Mombasa. There were some badly stained blue bodies whose nature could not be determined, and no further material was available.

Trypanosomiasis.—Four cases were examined for trypanosomiasis. In one the parasite was found in the blood and in the other three cases gland punctures were made. These gave positive results in two cases; in the third case the glands felt like small hard masses, and no fluid could be got from them. It seemed possible that this case had been treated by atoxyl in Uganda. If this were the case the condition of the glands would be accounted for. All four cases had been in Uganda.

Filaria.—In one of the sleeping sickness cases *filaria perstans* was seen. Systematic examinations were made of a series of cases in the native hospital, blood slides being taken at 9 p.m. In no case were any filaria seen. These patients included Indians and natives from various parts of the East Africa Protectorate.

Spirillosis Hominis.—One case of tick fever in the native has been seen. This man had come from Embu, and had been more than a month in Nairobi, so that it seems that he must have contracted the disease here. The case was an interesting

one, as the disease followed the same course as it does in the monkey when it ends fatally. A very bad prognosis was given when it was found that the temperature was falling without disappearance of the spirochætæ from the peripheral circulation. The patient sank into a comatose state with subnormal temperature and died. Post mortem the changes were those seen in the experimental disease in the monkey, slight enlargement of liver and spleen, petechiæ in lungs, liver and spleen. The mucous membrane of the stomach also showed small hæmorrhages.

From this case it would seem that, as in the monkey, a fatal ending is preceded by fall of temperature, large leucocytosis, with the presence of very large numbers of spirochætæ in the peripheral blood. Where the disease runs its usual course, the parasites disappear from the blood and the temperature then falls, and the patient feels almost well till the next relapse.

Tubercle.—Fifteen specimens of sputum and two of urine were sent for examination. In two of the sputa and one urine tubercle bacilli were found. It seems to be a very serious matter that the two tubercular sputa came from natives who belonged to distant tribes not much in contact with civilisation. Even if these men had not contracted the disease before they came to Nairobi, their return to their houses must mean the spread of the disease, and the conditions under which most of the natives live—dark huts, earth floors and at night the prevention as far as possible of all ventilation—are conditions which should favour in the highest possible degree the infection of villages and rapid extension of tubercular disease.

Enteric Fever.—Widal tests have been carried out in 10 cases. In two—one native one European—there were positive results.

One of the patients, whose blood gave no reaction, died, and post mortem there was found to be ulceration of Peyer's patches, but there was also ulceration of the stomach, and there was no enlargement of the spleen. From the spleen there was grown in pure culture a bacillus. Cultures of this bacillus were almost indistinguishable from typhoid cultures, but the bacillus was rather larger and much more sluggish than the *B. typhosus*. When a serum was obtained which agglutinated the stock typhoid culture, it was also tried on this other bacillus but failed to agglutinate it even in dilutions of 1 : 30.

Dysentery.—Nine specimens of fæces were sent for examination. In five of these the *Amæba histolytica* was found; in one only the eggs of *Oxyuris vermiculari* and in one *Amæba colis* and eggs of *Trichocephalus trichiurus* were found. The examination of two specimens was negative. There was also a specimen of sprue stool.

Gonococcus.—Two specimens of urethral discharge were sent for examination for Gonococci.

Police Examinations.—Two examinations were made for the police, one for blood stains and one for Spermatozoa.

Water Analysis.

Five water samples were sent for analysis. One of these—from Limoru—was a very good spring water.

A sample of flour was sent by the Uganda Railway for an opinion as to its fitness for human consumption.

Minerals.—Three samples of minerals were sent; since the arrival of Mr. Joll, the mining expert, the laboratory has been relieved of the work.

Pathological specimens sent for section and examination.

Fifteen specimens were sent for section and examination. The results of the examinations were as follows:—

1. Tumour from Entebbe, Uganda. *Ostea Sarcoma*.
2. Tumour from Dr. Crawford, Church Missionary Society Mission, Fort Hall. *Chondrosarcoma*.
3. Testicle. Entebbe. Inflammation.
4. Leprous Nodule. Mombasa.
5. Liver. Nairobi. Spirochætæ of tick fever.
6. Tumour of arm. Nairobi. Mixed round and spindle-celled Sarcoma.

7. Spleen and liver. Mombasa.
Liver.—Cloudy swelling. Spleen.—Nil.
8. Brain. Nairobi. Malarial parasites.
9. Ox. Nairobi.
Lung.—Pleuro pneumonia.
Lip.—Pleuro pneumonia, probably result of native inoculation.
10. Brain. Nairobi. Typical changes of sleeping sickness.
11. Testicle. Nakuru. Round-celled Sarcoma.
12. Lung of pig. Nairobi. Nil.
13. Liver of sheep. Nairobi. Cirrhosis.
14. Tumour of skin. Mombasa. Doubtful, malignancy.
15. Tumour. Nakuru. Round-celled Sarcoma.

Vaccine.—800 tubes of glycerinated vaccine have been made. Thirty-three dozen of these tubes have so far been distributed, but no results are available.

Trypanosomata of Glossina fusca.

In the light of the discoveries by Gray and Tulloch of trypanosomata in the gut of the *Glossina palpalis*, and of Novy's subsequent comments and his more recent work on the trypanosomata of the mosquito, it seemed to be a matter of some interest to examine the other tsetse flies, to determine whether or no they harboured the same or similar parasites. The fly available was the *Glossina fusca*, and I propose to describe first, in detail, the results of the examinations. All these flies came from Kibwezi; on arrival, except for the few that were dissected at once, the flies were fed on a dog, either infected or clean, and every day, until the last fly had been used, they were given an opportunity of feeding again, those that had fed on a clean dog on the same dog, and those that had fed on an infected dog, on another clean dog except in the experiments A., B., C., D., where flies were fed again on infected dog. The infected dog had been inoculated with a trypanosoma from a mule, this trypanosoma bearing a morphological resemblance to the *trypanosoma dimorphum*. Each fly was caught in a test tube, killed with chloroform, pinned out, the abdomen opened, and when the body fluid was required it was drawn up in a capillary tube. The intestines were then dissected out and put in a drop of normal saline.

A.—August 22nd. Flies fed on infected dog No. 99.

August 23rd. Three flies examined showed trypanosomata fairly numerous.

August 24th. Two flies examined showed nothing. Remaining flies fed again on a dog, No. 99.

August 26th. Three flies examined—negative.

August 27th. Six flies examined—negative.

One fly examined showed numerous trypanosomata. Thus fifteen flies were fed on August 22nd. After 24 hours five flies were examined and two showed nothing. Of the ten remaining flies fed on August 24th one only, and that after 48 hours, showed trypanosomata. Apparently, therefore, feeding on a dog whose blood shows a high trypanosomata infection does not ensure one finding the parasites after even 24 hours, though one may find parasites after 48 hours.

B.—The above experiment was repeated with six flies.

August 27th. Flies fed on dog 99.

August 28th. One fly, which had not fed, showed very scanty trypanosomata. Three flies which had fed were negative.

August 30th. Two flies which had fed again on August 28th were negative.

This seems to confirm the conclusion arrived at in A.

C.—September 9th. Flies fed on infected dog 101.

September 10th. After 20 hours.

One fly—very scanty trypanosomata.

One fly—scanty trypanosomata in the bright unaltered blood of fore gut, but very many in the dark, altered blood of hind gut. Many rosette forms were seen in this latter and agglomeration proceeded without any loss of motility.

One fly—trypanosomata more plentiful in altered than in unaltered blood. No rosettes nor agglomeration.

September 11th. One fly—negative.

One fly—no parasites in unaltered blood, swarms of trypanosomata in the altered blood.

The body fluid of this last fly was examined but nothing found.

September 12th. One fly—negative.

Two flies—many trypanosomata in altered blood.

September 13th. One fly—very many trypanosomata.

September 14th. One fly—trypanosomata plentiful.

There seems to be nothing here to modify the conclusion A. Feeding on an infected dog did not result in all flies being infected, and the numbers present in three flies examined 20 hours after feeding varied very much, though presumably, if the trypanosomata were the result of development of the parasite taken from the dog, there should have been about the same numbers in each fly. On the other hand, after four and five days' starvation swarms of trypanosomata were found in two flies and nothing at all in a third.

D.—Flies fed on infected dog No. 102 on September 12th, afterwards fed on clean dog No. 98.

September 13th. One fly—fairly numerous trypanosomata.

September 16th. One fly—gut nearly empty but swarms of trypanosomata of most various shapes and sizes. Many were typical, others were rounded, and in others, again, the position of the centrosome varied, in some being posterior to, in others beside, and in others anterior to the nucleus. In nearly every one the undulatory membrane was clearly visible. Masses of these trypanosomata were attached to the wall of the gut by their flagella, but this attachment was not permanent, for occasionally one could be seen to move away and then return again to the gut wall.

September 18th. One fly—negative.

One fly—intestinal contents negative but body fluid showed a few degenerating trypanosomata.

September 19th. One fly—intestinal contents negative. Body fluid showed a few faintly stained trypanosomata.

September 20th. One fly—body fluid negative. Intestine—swarms of parasites as various in shape and size as those seen on September 16th, with the exception of the fact that in no case was the motor nucleus seen anywhere but posterior to the trophic nucleus.

Attempts were made to agglutinate these trypanosomata by (1) serum from dog 102 on which the fly had fed on September 12th, and (2) by goat serum.

(1) Serum of infected dog.—There was loss of motility in a few minutes in the case of the normal forms. The long forms were less affected, there being no immediate loss of motion but apparent decrease of locomotion. After one hour no trypanosomata could be seen moving, but there was no agglutination.

(2) Goat serum.—This had no effect, the parasites being as active as ever after one hour, and some could still be seen moving after $2\frac{1}{2}$ hours, whereas in (3) the control, in normal saline, though active after 65 minutes, none could be seen moving after $2\frac{1}{2}$ hours.

September 21st. One fly—negative.

September 23rd. One fly—negative.

The results so far as regards the effect of feeding on an infected dog confirm the conclusion A. The question arising from the agglutination experiments will be discussed later.

E.—Two flies fed on September 21st, one on infected dog No. 102 and one on clean dog.

September 23rd. Both flies showed swarms of trypanosomata in the intestine.

The conclusion is that the feeding of the fly on the infected dog probably had nothing to do with the parasites in its intestine. They were neither more nor less in number than, nor did they differ in, appearance from the trypanosomata in the fly that had fed on the clean dog.

F.—September 24th. Three flies fed, two on infected dog and one on clean dog.

September 26th. One fly—infected dog—trypanosomata numerous, not affected by goat serum.

One fly—infected dog—negative.

One fly—clean dog—negative.

G.—September 21st. One fly fed on dog 102.

September 24th. Three flies fed on clean dog.

September 27th. All four flies—negative.

H.—September 24th. Seven flies fed on infected dog. One fly fed on clean dog.

September 30th. Two flies—infected dog—negative.

One fly—infected dog—very scanty trypanosomata.

October 2nd. Two flies (one clean dog)—negative.

October 3rd. Three flies—negative.

I.—September 28th. Three flies fed on infected dog. Two flies fed on clean dog.

October 3rd. Two flies—infected dog—negative.

October 4th. One fly—infected dog—very scanty trypanosomata.

One fly—clean dog—trypanosomata fairly numerous, both normal and rather stumpy forms being seen. The addition of goat serum resulted in partial agglutination without loss of motility, but it was found that the control in normal saline showed the same change but in lesser degree.

October 5th. One fly—clean dog—trypanosomata numerous. No agglutination by addition of goat serum, but some slight grouping was seen in the control.

In this specimen an opportunity occurred of watching the method of division. This does not appear to be at all the simple operation usually described. When first seen division was just beginning in the flagellum. This extended in the usual manner, and resulted in division into a large and small element: the small element quickly swam out of the field. The large trypanosoma now left immediately began to divide, division beginning as before at the flagellum. Division proceeded till complete, except in the posterior sixth of the parasite. Instead of proceeding further, the divided parts suddenly came together and fused completely. The resulting body then gradually lengthened and appeared to be going to divide transversely, but when almost complete the whole doubled on itself and the two ends again fused. The body then again lengthened and prepared for transverse division, which this time was apparently complete, as the two elements got some distance apart and no connection could be seen. But instead of separating as expected the two bodies again came together and twisted like the strands of a rope, becoming fused again almost at once into an apparently normal trypanosoma. There then followed in turn incomplete longitudinal division, fusion, incomplete transverse division, fusion, and finally, complete longitudinal division, which resulted in the formation of two equal trypanosomata. But whereas the body in process of division had been exceedingly active—though not moving much about the field, the two elements, the result of the division, immediately became very sluggish, moving rather in a series of jerks than with the constant lashing movement of the trypanosoma.

The trypanosomata found in the *Glossina fusca* in one respect do not resemble the *T. Grayi* nor the *T. Tullochi*. The flagellum seldom extends more than $2\text{--}3\mu$ beyond the body. The most usual form met with resembles the trypanosomata of the mule, referred to above, in the arrangement of nucleus and centrosome. The latter is usually a small dot, but may take the form of a short rod; it is usually situated at the extreme posterior end. The nucleus is always anterior to the centrosome and is round or oval in shape. A diplosome can sometimes be seen. The normal shaped forms are $25\text{--}35\mu$ in length by $1.5\text{--}2\mu$ broad; but, besides these every kind of distorted form can be seen, the commonest form being club-shaped, $15\text{--}20\mu$ long and $3\text{--}5\mu$ broad at the broadest part. In some flies the trypanosomata have been much larger, $30\text{--}45\mu$ in length by $2\text{--}4\mu$ broad, the commonest forms being about 35μ long. In these forms the centrosome is usually some distance— $2\text{--}4\mu$ —from the posterior end, and is usually rod-shaped; the nucleus is oval or irregular in shape. In the same flies in which these forms of trypanosomata were found there were also numerous quite circular forms, $4\text{--}7\mu$ in diameter. The nucleus of these is round and usually centrally situated, the centrosome, round or rod shaped, being usually nearer the periphery. From the centrosome a well-marked flagellum extends either directly outwards or circles for some distance round the circumference with only the terminal portion extending from the main body of the parasite. The flagellum is $10\text{--}12\mu$ in length. In one fly, while these circular forms were fairly common, there were enormous numbers of long forms in which the relative positions of the centrosome and nucleus were exceedingly variable. In some the centrosome was immediately behind the nucleus, in others beside, and in others anterior to the nucleus. In these forms the posterior end of the trypanosoma was rounded, not rather pointed as in the other forms described; the centrosome, when posterior, was seldom quite terminal; it was usually rod-shaped and the nucleus oval.

As regards agglutination by goat serum the results were unsatisfactory, and certainly do not so far agree with the results obtained by the Sleeping Sickness

Commission. Cultivation of the trypanosomata has so far failed. It would seem that there are several trypanosomata of the tsetse fly. Among those described above there would appear to be, at any rate, three distinct forms: (1) the forms, normal in shape but larger than the animal trypanosomata; (2) the very large forms; and (3) the "cultural" forms. The relationship between these forms and the circular bodies is still undetermined, and the results are still too few for any definite conclusion to be drawn.

Parasites of Bycanistes.—In the last half-annual report the discovery of trypanosomata and filaria in the *Bycanistes cristatus* was noted and measurements given. Microphotographs* of these parasites are now included. During the past six months there has been noted the finding of a trypanosoma in a *Bycanistes* on the West Coast of Africa.

Examination of Stomoxys.—The intestinal contents of many stomoxys have been examined, but in only one series of flies was anything found. These flies were caught on a mule known to be suffering from trypanosomiasis, and trypanosomata were found in the intestinal canal of the flies examined soon after capture. In one fly there was also found an active filaria embryo 185μ in length by 8μ in thickness.

PHILIP H. ROSS.

October 15, 1907.

Enclosure 2 in No. 12 in Appendix VII.

(No. 63.)

SIR, Principal Medical Officer's Office, Nairobi, November 2, 1907.

I HAVE the honour to forward the half-yearly report of the Bacteriologist for April-September, 1907.

Since the last half-yearly report was submitted the laboratory has been moved into a new building in which greater facilities for good work exist. One room has been set apart and equipped for water analysis and another for the preparation of calf lymph. Although the latter has only been recently inaugurated, the lymph has given very satisfactory results, and it will now be possible to carry out vaccination on an extensive scale in both Protectorates.

As stated in the last report spirillum fever has established itself in East Africa. The tick (*Ornithodoros Moubata*) has been found in the Ngong Valley, some 15 miles from Nairobi, and no doubt exists in other localities in the Protectorate.

The case of spirillum fever commented on by Dr. Ross is exceptional in that it proved fatal *per se*, and appears to correspond more to the type of the disease met with on the Zambesi, and in several localities in the Congo than in that seen in Uganda, where death from this disease *per se* is extremely rare.

Tubercle.—The number of specimens examined for this disease was small, but medical officers usually carry out this examination themselves, and only in doubtful cases or where the result has been negative do they send specimens to the Bacteriologist. There is, however, no doubt that this disease is being introduced among the natives who, especially up-country natives, have hitherto been remarkably free from it, and once introduced it must, owing to the way in which they crowd themselves into their huts at night, with every possible means of ingress of fresh air stopped up, spread with great rapidity. Indians, and to a certain extent Somalis, are responsible for its introduction. It is worth considering whether it would be possible to prevent Indians suffering from tubercular diseases from emigrating to this country.

Dr. Ross's remarks on the varieties of trypanosomes found in the intestines of *Glossina fusca* go to confirm the observations of Gray, Tulloch, Novy and Koch on *Glossina palpalis*.

I have, &c.,

J. WILL,

Principal Medical Officer.

The Secretary
to the Administration.

* Not reproduced.

APPENDIX VIII.

THE SECRETARY OF STATE TO THE GOVERNORS OF ALL COLONIES,
&c., NOT POSSESSING RESPONSIBLE GOVERNMENT AND THE HIGH
COMMISSIONER OF CYPRUS.

(Circular.)

SIR, Downing Street, December 23, 1907.

THE Advisory Committee of the Tropical Diseases Research Fund have constantly had under their notice the excellent work which is being done in the various laboratories and research institutes in the Colonies. They are impressed with the importance of obviating, as far as possible, overlapping of work with consequent waste of energy, funds, and opportunity, and of securing that year by year some items shall be added to the common stock of scientific knowledge.

2. With this view they have made suggestions as to the organisation of present and future laboratories, and as to the directing of research work, which they have communicated to me, and which I, in turn, communicate and recommend to you as indicating the general lines on which a uniform system, fruitful of results, is likely to be produced. It is recognised that any rules or instructions to those engaged in research must not be of a character so stringent as seriously to interfere with the worker's individuality or predilections or to hamper him in pursuing any special line of research which local and possibly passing circumstances may put in his way. With this proviso it is suggested that the following rules are reasonable and might usefully be adopted:

- (i.) The Director of each laboratory, on taking over charge, should receive from his predecessor, together with an inventory of the properties of the laboratory, a full record of the investigations already carried out by the laboratory. These, together with a record of his own work, he should, in turn, hand to his successor. All such records should be kept in special indexed books, and be regarded as the property of the laboratory.
- (ii.) The Director of a Colonial Laboratory should, and no doubt will, preferably devote himself to the study of diseases endemic in—particularly those more or less special to or prevalent in—the Colony to which he has been appointed, and it is suggested that, on appointment and from time to time subsequently, the Tropical Diseases Research Fund Committee might with advantage furnish him through the ordinary channels of the Secretary of State, the Governor, and the Principal Medical Officer, with a general statement of the main features of the local pathology which he is expected to investigate, this statement to be supplemented and elaborated by the retiring Director.
- (iii.) It will be the duty of the Director from time to time, when asked to do so, to endeavour to clear up some special point in the local pathology of the Colony or of a district of the Colony, and to indicate the particular method or methods by which the desired knowledge may be sought for and obtained. The medical service of the Colony, for instance, may at any given time be faced with some new disease or some new phase of an endemic disease, in regard to which the Principal Medical Officer may think a special line of research to be required; or the Tropical Diseases Research Fund Committee, comparing notes from different Colonies, may conclude that in a particular Colony may be found the solution of some outstanding difficulty. In such cases the Director of the Laboratory should, and no doubt will, be prepared to concentrate his energies for the time being on the point at issue.
- (iv.) The Director should, as far as possible, devote his attention to actual work in his laboratory, and, if not fully occupied in such an investigation as has been suggested in the last paragraph or in the more routine duties of his appointment, he should take up some definite work of research. In that case it is recommended that he should, through the ordinary channels, communicate to the Tropical Diseases

Research Fund Committee the object which he has selected and the general lines on which he proposes to work, in the hope that the Committee may both at the outset and as the work proceeds be able to help him with suggestion, information, or advice.

- (v.) It is suggested that publication of work by the Director of the Laboratory as such and in the name of the laboratory should receive the previous sanction of the Colonial Government, whom the Tropical Diseases Research Fund Committee will be pleased to advise in case of doubt.
- (vi.) All Directors of Colonial Laboratories should continue, as now, to furnish the Colonial Governments and, through the Governments, the Tropical Diseases Research Fund Committee, with half-yearly reports of work completed, in progress, and in contemplation, such reports to be, as far as possible, in a form suitable for publication, and to be forwarded not later than the 1st February and the 1st August in each year. The Committee may, from time to time, ask for special reports, and the Colonial Governments and Directors will no doubt meet their wishes as far as possible.

3. I would repeat that these suggestions are not intended unduly to fetter discretion, but in view of the growing importance and volume of tropical pathology, and the obviously exceptional advantages for study, research, and discovery which the Empire possesses in the number and variety of its tropical colonies, I strongly commend these proposals to your attention, and also invite counter proposals, having the same object in view. That object is to produce uniformity of action, and the means to this end is that each laboratory working under its own local and climatic conditions shall supplement the others, the results being compared, inferences deduced, and consequent recommendations made by a central advisory body in England, offering guidance, which I do not doubt will be as readily accepted as it is given.

I have, &c.,
ELGIN.

TROPICAL DISEASES RESEARCH FUND.

REPORT

OF THE

ADVISORY COMMITTEE FOR THE TROPICAL DISEASES RESEARCH FUND

FOR THE YEAR 1908.

(For Report for 1907 see [Cd. 3992].)

Presented to both Houses of Parliament by Command of His Majesty.
March, 1909.



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REPORT

OF THE

ADVISORY COMMITTEE FOR THE TROPICAL DISEASES RESEARCH FUND FOR THE YEAR 1908.

The Advisory Committee for the Tropical Diseases Research Fund was constituted by the Secretary of State for the Colonies in July, 1904, and is now composed as follows:—

The Right Honourable Sir J. West Ridgeway, G.C.B., G.C.M.G., K.C.S.I.,
P.C. (Chairman).
Sir Thomas Barlow, Bart., M.D., K.C.V.O.
Sir Thomas Holderness, K.C.S.I.
Sir Charles Lucas, K.C.M.G., C.B.
Sir Patrick Manson, M.D., K.C.M.G., F.R.S.
Sir Ralph Moor, K.C.M.G.
Dr. J. Rose Bradford, F.R.S.
Surgeon-General A. M. Branfoot, C.I.E.
Mr. H. J. Read, C.M.G.
Mr. A. Berriedale Keith, Secretary.

The revenue of the Tropical Diseases Research Fund for the year 1908 was made up as follows:—

Contribution from the Imperial Government	...	...	£1,000
„ „ the Government of India	...	...	500
„ „ the funds at the disposal of the Rhodes trustees	...	...	200
„ „ Colonial Governments in the following proportions:—			
Commonwealth of Australia	...	...	200
Gold Coast	...	...	200
Southern Nigeria	...	...	200
„ „ (Lagos)	...	...	150
Ceylon	...	...	100
Straits Settlements	...	...	100
Federated Malay States	...	...	100
Hong Kong	...	...	100
Trinidad	...	...	100
Fiji	...	...	100
Sierra Leone	...	...	100
Gambia	...	...	100
British Guiana	...	...	100
Grenada	...	...	50
			£1,700
making in all a total of	...	...	£3,400

The expenditure of the year consisted of grants as follows :—

	£	s.	d.
Grant to the London School of Tropical Medicine ...	1,333	6	8
„ the Liverpool School of Tropical Medicine ...	1,000	0	0
„ the University of London	750	0	0
„ Cambridge University	100	0	0
„ the Australian Institute of Tropical Medicine	400	0	0
making in all a total of £3,583 6s. 8d., of which £183 6s. 8d. has been defrayed from the accumulated surplus of the fund.			

Of the grant to the Liverpool School of Tropical Medicine (£1,000), half was employed by the School for the appointment and the salaries of a Lecturer in Economic Entomology and Parasitology and of a Lecturer in Tropical Medicine; both these lecturers are required to devote their spare time to research.

The other half of the grant was utilised for the following purposes :—

In part payment of the expenses of the Sleeping Sickness Expedition sent by the Tropical School to Rhodesia; in part payment of the expenses of the research work on tropical diseases at present being carried on at the Runcorn Laboratories of the School; and in part payment of the cost of the publications on the research work at Runcorn and the research work of the Sleeping Sickness Expedition.

A programme of the work to be done was submitted by the Tropical School to the Advisory Committee, and was approved by the Committee. It was found possible to give effect to the increase in the grant from £500 to £1,000 a year from the 1st of October, 1907, instead of the 1st of April, 1908, as contemplated in the report of the Advisory Committee of 1907.

Of the grant of £1,333 6s. 8d. to the London School, the sum of £1,000 was devoted to the payment of the salary of a Teacher and Investigator of Protozoology and of the salary of a Teacher and Investigator of Helminthology, and to the provision of suitable apparatus, &c. The sum of £333 6s. 8d. was employed in defraying the expenses in connection with the appointment of an Arthropodologist, whose post was established in 1907 by means of a grant from the Tropical Diseases Research Fund.

The grant of £750 to the University of London was expended in paying the salary of the Professorship of Protozoology, which was established in 1906 by means of a grant from the Tropical Diseases Research Fund.

The grant of £100 to the University of Cambridge was made in respect of the Research Studentship in Medical Entomology established on the advice of Professor G. H. F. Nuttall in 1907, by means of a grant from the fund.

No grant was made to the Royal Society from the fund during the year, as it was found possible, as in 1907, to supply the sums required for the continuation of the researches as to sleeping sickness, which have been carried on under the supervision of the Society, from the funds of the Uganda Protectorate. The Society is carrying into effect the research work of which a programme was submitted in 1907 to the Advisory Committee, and which has received the approval of the Committee.

The Committee are glad to note that generally a very favourable reception has been given by the Colonial Government to the suggestions which were made by their advice in the Secretary of State's despatch of the 23rd of December, 1907,* as to the adoption of certain methods for preserving the results obtained by research in Colonial laboratories and rendering them accessible to the successive officers in charge. As stated in that circular, the Committee have no desire in any way to fetter the freedom of the officers in charge of the laboratories; but are ready and willing to co-operate with or assist those officers.

The scientific members of the Committee were consulted by the Secretary of State with regard to the selection of a Director for the Central Research Institute, which has been established by their advice in Southern Nigeria. They recommended for the post Dr. W. M. Graham, a medical officer of the Gold Coast Colony, whom they considered to be especially fitted for the appointment in question. Dr. Graham, whose selection was approved by the Secretary of State, is now studying with a

* Printed in [Cd. 3992], p. 156,

view further to fit himself for the post, and he will proceed shortly to Southern Nigeria to inaugurate the laboratory. Steps have also been taken to select an assistant to the Director, while the necessary buildings have been constructed at the cost of the Governments of the Colonies and Protectorates of the Gambia, Sierra Leone, the Gold Coast, Northern Nigeria, and Southern Nigeria.

The Secretary of State also referred to the Committee an application from the Bishop of North Queensland for a grant towards the expenses of a proposed Australian Institute of Tropical Medicine. The Institute is to be established at Townsville, in Queensland, which is within the area of tropical diseases, and is the first large port of call for vessels coming to Australia from the Far East. The area of investigation will not be restricted to North Queensland, but will include probably the Northern Territory of Southern Australia and the islands adjacent to the North Queensland coast. The Committee of the hospital at Townsville have undertaken to set aside, free of cost, several buildings for the initiation of the work of research; the Queensland Government have promised a subsidy of £250 a year, and the Commonwealth Government a subsidy of £450 a year, towards the work of research. It is intended that a Committee of Management shall be selected consisting of one representative from each of the Universities of Melbourne, Sydney and Adelaide, and a representative of the Government of Queensland, while the financial management of the Institute will be in the hands either of the Senate of the University of Sydney or of the Council of the University of Melbourne if the Senate of the University of Sydney are unable to undertake the management. The first Director is to be selected in conjunction by the Royal Society and the London and Liverpool Schools of Tropical Medicine. His appointment is to be for a term of years not exceeding five, and the salary will be at least £600 a year, combined with a free passage to Australia. It is estimated that the initial cost of a passage for the Director and for his assistant, for the fitting up of the laboratory, the provision of apparatus and materials, the purchase of books and journals, &c., will amount to about £1,000, and the annual expenditure will also be about £1,000. The Bishop of North Queensland was anxious to obtain a grant of £300 a year for a term of years from the Advisory Committee, but in view of the heavy demands on the funds at the disposal of the Committee, they were unable to do more than to propose a grant of £400 as a donation, on the understanding that the funds to inaugurate the Institute would be obtained from some other source. They are glad to be able to report that, as a result of the efforts of the Bishop of North Queensland, a donation of £1,000 has been obtained from Mr. D'Arcy, of Queensland, and a grant of £400 has, therefore, been made from the Research Fund, as there is every prospect that once the Institute is started further contributions for its maintenance will be obtained in Australia. The Committee have every confidence that the Institute will further scientific research in Australia, and will add greatly to the knowledge of tropical diseases, and they hope in future reports to include some account of the work done by the Institute.

Steps have been taken during the year by the Liverpool School of Tropical Medicine to modify the course of instruction at the School. The Autumn and Lent courses, which hitherto have lasted only ten weeks, have been extended to thirteen weeks, followed as at present by the examination for the Diploma in Tropical Medicine given by the University. In order to allow of this change, the present Summer term has been replaced by a short course of practical instruction in Tropical Pathology and Medical Entomology lasting for four weeks in June and followed by a class examination, with a certificate of satisfactory attendance, the acquisition of which excuses attendance for the first four weeks of the full Autumn and Lent courses. The Committee have noted with satisfaction the steady improvement in the standard of the requirements for the Diploma of the School.

The Committee desire also to record the satisfaction with which they have learned during the year of the establishment of a Sleeping Sickness Bureau in London for the collection and the distribution of all information relative to a disease which has caused so much havoc in the East African Dependencies of the Empire. The Committee are represented on the Managing Committee of the Sleeping Sickness Bureau by Sir West Ridgeway, Sir Patrick Manson, Dr. Rose Bradford, and Mr. Read, and they have every confidence that the establishment of the bureau will, with the co-operation of Foreign and Colonial Governments, be of great assistance to all those who are interested in combating this disease. They

have learned with much pleasure of the Agreement recently concluded with the German Government for mutual assistance and information in this connexion in the German and British Colonies and Protectorates in East Africa.

The Committee have also had under their consideration a proposal by Dr. W. M. Strong, the acting Chief Medical Officer of Papua, suggesting that a scientific expedition should be sent to that dependency, for the purpose of investigating tropical diseases. The Committee consider that Papua offers a great field for important work on tropical diseases, but they have suggested that the question of an expedition might more suitably be considered after the establishment of the Institute at Townsville. It might be possible for the Director of the Institute or for his assistant, to take part in the expedition.

The Committee append to their report, as was the case last year, a summary of the efforts made in the Colonies to combat malaria, and of the result of these efforts. They also append reports of the work done at the Liverpool and London Schools of Tropical Medicine for the year November, 1907, to October, 1908; the report of the Professor of Protozoology at the University of London and of the Research Student in Entomology; a report from the Royal Society on the experiments as to sleeping sickness, and reports on the work done at, and the organisation of, several Colonial laboratories, which have been sent in accordance with the requests made by the Secretary of State in December, 1906, and December, 1907. In these reports will be found full details of the work done and of the papers published in connection with the grants made by or under the supervision of the Board. The Committee are satisfied that the work continues to be of a high order of merit, and fully justifies the continuance of the grants.

WEST RIDGEWAY,
Chairman.

A. BERRIEDALE KEITH,
Secretary.

22 February, 1909.

APPENDIX I.—EAST INDIES.

CEYLON.

HOSPITAL RETURNS, 1907.

APPENDIX.

MEASURES TAKEN TO ERADICATE MALARIAL FEVER IN CEYLON DURING 1907. .

In compliance with the order of the Right Honourable the Secretary of State contained in circular despatch of June 6, 1906, to make a special report yearly on the measures taken to eradicate malarial fever, I have the honour to submit my remarks.

2. In a similar report for 1906 the rainfall and general configuration of the Island were described.

3. The general principles for the prevention of malaria, namely, (a) by educating the public as to the cause of malaria and how to prevent it, (b) improved sanitation, and (c) the use of quinine as a prophylactic, were continued this year.

4. (a) *Education*.—Thousands of pamphlets printed in the English, Sinhalese, and Tamil languages have been widely distributed. In them the cause and prevention of malaria have been described in a simple and popular manner. The synopsis of a popular lecture on this subject has been sent to every medical officer and apothecary, and these have been instructed to lecture to the inhabitants living in their immediate neighbourhood. The provincial surgeons have also been instructed to lecture to the people on their tours of inspection. On the whole, the attendance at these lectures has been satisfactory, and some good will have been accomplished, but the natives receive this new doctrine as to the cause of “fever” with much scepticism, which is not to be wondered at when it is remembered with what tardiness the medical profession accepted it when it was first promulgated. The native further argues, with some reason, that he cannot understand why he should take medicine when he is well. He recognizes the value of treatment when he is ill.

5. (b) *Sanitation*.—In all the Provinces more attention has been paid to improved sanitation, more especially with regard to the cleaning up of individual compounds. In many places the surrounding brushwood and low jungle have been removed from the immediate neighbourhood of dwellings, pots and broken vessels likely to collect water have been rendered innocuous. Small hollows have been filled up and attention has been paid to improve drainage; but no works on any large scale have been carried out. These are receiving the attention of His Excellency the Governor, who has a scheme for the gradual improvement of the sanitation of those parts of the Island where malarial fevers are most prevalent.

6. (c) *Quinine as a Prophylactic*.—In 1906 paid distributors were employed to carry the remedy to the remote villages and small towns. This was a very expensive and unsatisfactory arrangement, for there was no check over the amount of the drug distributed nor as to the number of people who received it. There was reason to believe that the distributors did not perform their duties honestly, and that they sold the remedy to those actually suffering from fever. Therefore, in 1907, paid distributors were discontinued, and headmen and others holding respectable positions were supplied with quinine for distribution free to any person applying for it. This change in the manner of the distribution of the drug has not got into proper working order yet, and the numbers returned in 1906 as having been treated were less numerous in 1907. Returns from many of these voluntary distributors are not available, nor is evidence available as to the incidence of the disease in those undergoing protective treatment for comparison with those who did not take the prophylactic.

7. The compulsory treatment of children in schools and of prisoners in jails has been continued this year, with marked success. The sick rate from malaria has been very low in the prisons, and the attendance of children in schools, I believe, has been regular.

8. The following is a synopsis taken from the reports of the provincial surgeons as to the measures adopted:—

Western Province.—General sanitary improvement of compounds; quinine prophylaxis in jails and schools.

Central Province.—The issue of free quinine to the general public and schools; 128 villages were supplied and 11,606 persons treated. Education as to the cause and prevention of malaria and improved sanitation.

Northern Province.—187 villages were selected for the distribution of free quinine, the estimated population of which was 188,097. 15,801 of these took the remedy for two consecutive days weekly for ten weeks during the fever season. Of these, 2,864 suffered from fever, 12,488 remained free from disease.

Attempts have been made to fill up hollows and to improve drainage. The general improvement in the sanitation of private compounds has been more or less enforced. Pamphlets in the vernacular have been distributed and lectures given.

North-Western Province.—Improved sanitation in general, filling up hollows, burning rubbish, improved drainage, the clearing of brushwood near dwellings. The education of the masses in malaria. The distribution of quinine in six of the most malarious districts, which contained 431 villages with a population of 129,692. 18,552 of these took the remedy.

North-Central Province.—In the principal town (Anuradhapura) the jungle was cut down near dwellings, hollows have been filled, other collections of water have been oiled, the delivery of popular lectures in various parts of the Province. The free distribution of quinine to the people and to schools. 33,279 individuals took the remedy.

Province of Uva.—Popular lectures at various centres. Quinine distribution to school children.

Province of Sabaragamuwa.—Popular lectures have been given, but the distribution of quinine has been carried out indifferently.

Eastern Province.—Improved sanitation and drainage and the filling up of hollows. Compounds cleaned, jungle cleared, quinine distributed to the public and to the schools in malarious districts.

Southern Province.—Instruction by popular lectures by the provincial surgeon, medical officers, and apothecaries. The issue of free quinine to 3,567 school children and to 29,813 persons living in the most malarious districts.

9. The amount of quinine expended during the year was 76,206 ounces, the cost of which was Rs. 50,295.96. There was no special expenditure on engineering works in connection with the prevention of malaria. The improved drainage was carried out locally.

A. P.

January, 1908.

MAURITIUS.

MEDICAL REPORT, 1907.

(Extract.)

Anti-Malarial Campaign.—The Council of Government voted Rs. 10,000 to continue the works for the prevention of malaria during the financial year 1907-08.

The draining of the numerous marshes at Clairfond, Phoenix, where a severe epidemic of malaria had broken out at the end of 1906, was the main feature of the anti-malarial campaign in 1907.

Extensive works consisting in the deepening and banking up of canals, the draining of pools and puddles in the locality were undertaken with the result that numerous mosquito-breeding places at Clairfond and its vicinity had been considerably reduced at the end of the year.

At Mon Plaisir, Pamplémousses, the works referred to in the last report were continued and trenches were dug across the ground which had been drained during the year so as to complete the drying up of the large marsh.

On the recommendation of the Malaria Committee, small sums were placed at the disposal of the Curepipe Board for sanitary works at Mare Lagesse, where satisfactory results have been obtained.

With the funds provided under item "Minor Sanitary Works" the following works were attended to:—

- (a) All the Curepipe rivers were cleaned during the year.
- (b) At Phoenix part of river du Mesnil was cleaned, its banks were regulated and cleared of vegetation, &c.

(c) The bed and banks of River Céré along its course through Centre de Flacq village were cleaned throughout.

(d) Belle Isle River at Bambous, Black River, was cleaned on a length of about $1\frac{1}{2}$ miles.

(e) The cleaning of part of other rivers was also carried out.

The distribution of quinine in malarious localities was carried out on the same lines as in the previous year.

FEDERATED MALAY STATES.

SELANGOR.

MEDICAL REPORT, 1907.

(Extract.)

In previous years malaria in Kuala Lumpur has been confined to the neighbourhood of the river; for at least twelve years the European quarters have been free. The houses occupied by Europeans are, for the most part, situated on small hills with valleys between. These valleys consist of marshy ground with, as a rule, a small stream running down the middle. Until 1906 these valleys were filled with a dense undergrowth which covered the swamps and streams and hid them from the light, thus preventing their becoming a breeding place for the anopheles mosquitoes. It was soon after the clearing of these valleys and in their neighbourhood that malaria broke out towards the end of 1906. On investigation it was discovered by the Government entomologist that while anopheles were absent from those streams covered by a thick undergrowth, wherever a sluggish stream or swamp had been uncovered by cleaning, there anopheles were present in large numbers. The outbreak is, in short, an illustration of the fact, well known to all planters, that clearing jungle brings malaria.

EAST AND WEST AFRICA.

EAST AFRICA PROTECTORATE.

PRINCIPAL MEDICAL OFFICER'S REPORT FOR 1907.

(Received in Colonial Office August 17, 1908.)

(Extract.)

* * * * *

Section V.—Measures carried out in 1907 to eradicate Malarial Fevers and other mosquito-borne diseases.

47. (a) Clearing bush and rank vegetation. This has been systematically carried out at all Government stations usually by means of prison labour. In East Africa, where, especially during the rainy seasons, vegetation springs up with great rapidity, much labour is required to keep it under, and only regular cropping will effect this.

(b) Drainage. This has been carried out in a general way at all Government stations for the purpose of carrying off storm water, but except in connection with the better drainage of Nairobi no extensive scheme of drainage in regard to the prevention of Malaria has been inaugurated.

(c) Levelling up and filling in water-collecting pits and depressions. This has been done to a certain extent, but not so systematically as is desirable. A township bylaw might, with advantage, be put in force to compel everyone, whether in Government employment or not, to fill in and level up when no longer in use all borrow pits which he may have been responsible for opening.

(d) Application of petroleum. This has been used in a few places, but is not recommended in any case in which more radical measures are practicable.

(e) Protection by means of mosquito-proof wire gauze. This means of protection is less widely used than it ought to be. In Kisumu all official quarters have wire gauze doors and windows, but the fitting is often imperfect. Its more extended use is recommended in Mombasa, where few of the official quarters are provided with gauze doors and windows.

(f) Prophylactic administration of quinine. This has not been systematically carried out, and it is still a moot question whether any beneficial action it may have in warding off malarial attacks is not more than counterbalanced by the digestive troubles it so frequently gives rise to.

(g) No legislative measures have been enacted dealing with this subject.

(h) Cost of anti-malarial measures. A vote of £2,500 was sanctioned in the Estimates for this purpose, but most of the work done in this connection has been by means of convict labour the value of which it would be impossible to compute.

(i) Statistics. Statistics regarding the effects of the above measures are not available.

* * * * *

J. WILL,
Principal Medical Officer

THE GOVERNOR to THE SECRETARY OF STATE.

(Received January 12, 1909.)

MY LORD,

Governor's Office, Nairobi, December 15, 1908.

IN reply to your Lordship's despatch of the 20th ultimo, I have the honour to transmit a memorandum by the Principal Medical Officer, October 5, 1908, shewing the steps that are being taken to destroy mosquitoes at Mombasa.

2. This memorandum should have accompanied my despatch of the 20th of October last, but was inadvertently omitted.

I have, &c.,

F. J. JACKSON,

(In the absence of His Excellency the Governor.)

Enclosure.

MEMORANDUM.

The rain water tanks are being provided with hand pumps which will obviate the necessity of drawing water by dipping buckets through the trap doors, thus allowing ingress and egress to mosquitoes, and the Public Works Department has been asked to inspect all tanks with a view to making them mosquito proof.

2. Bush clearing has been carried on and extended.

3. Provision is being made for the erection of public latrines in native quarters.

4. I understand another refuse destructor is to be provided.

5. The liability to contamination of the wells can only be remedied by introducing a gravitation water supply and filling them in. In some instances they also breed mosquitoes, but being mostly public wells, it would not be possible to keep them adequately covered.

J. WILL,
Principal Medical Officer.

Nairobi,

5 October, 1908.

SOUTHERN NIGERIA.

MEDICAL REPORT, 1907.

ANTI-MALARIA WORK.

(Extract.)

1. The reports show that in all places the usual action has been continued.

The main features of the work are:—

Use of quinine as prophylactic.

Destruction of mosquito-breeding grounds and larvæ.

Use of kerosine oil for collections of water which cannot be otherwise treated.

Clearing of "Bush."

Filling of swamp-land and surface depressions.

Use of anti-mosquito wire gauze for rooms and houses.

2. This last I still regard as one of the best anti-malaria weapons we have in this country, where the enormous area of mosquito breeding ground precludes complete destruction of mosquitos and prevention of a constant influx of the adult insect to areas where the local breeding places have been abolished.

In the towns and places where native dwellings are near to and commingled with those of Europeans, it is particularly desirable; in hospitals it is a necessity. The comfort, too, and protection against diseases conveyed by the abounding swarms of house flies and other insects, which result from the use of this wire gauze, are most important additional reasons for its employment. No one who has once fully appreciated the benefit but must feel that it is an essential to life in West Africa.

This, my own experience, is borne out by what is stated to be the case on the Isthmus of Panama, in Italy, and other places where the use of wire gauze-screened houses has become the rule. Not only has the effect on malaria been most marked, but bowel ailments due to pollution of food and drink by flies, have decreased remarkably, and the ordinary decomposition of food is found to be delayed for a longer period than was formerly the case. The risk of contracting filariasis (with its sequelæ) and trypanosomiasis—in certain places—and the other insect-borne diseases is, obviously, greatly lessened; and I cannot but urge once again that all houses should be so constructed as to permit of complete "mosquito-proofing" by wire gauze while allowing the maximum of light and air to enter.

After several years' personal experience of life in a mosquito-proof house, I most unhesitatingly and strenuously advocate the use of such houses in West Africa. I have above pointed out the benefit in regard to many diseases, but as regards malaria, if only all Europeans used them, the possibility of actually abolishing that disease among the European inhabitants of the large towns would be enormously enhanced; and there is little doubt that the intelligent portion of the native community would in time adopt the same precaution against the disease which annually destroys so vast a number of its infant population. To be of value to the European community as a whole, however, the use of such houses should be universal in it. At present the use of wire gauze is an undoubted and most important aid in preventing infection of the individual who is wise enough to avail himself of its protection, but, as I have shown in previous report, one who now escapes malarial infection while living in his own house is exposed to infection when he spends an evening in that of one who will not take the trouble to protect either himself or his acquaintances from the risk of contracting the disease during those periods of the year when anopheles are present. Among minor benefits conferred by the use of the mosquito-proof house, are, abolition of the use of the hot mosquito net (otherwise absolutely necessary), and of the need for taking quinine as a prophylactic, the latter procedure being then only necessary when travelling and exposed to the infection.

3. In order, however, to get, in this hot climate, the full benefit of the use of mosquito gauze with the minimum of resulting increase of heat, every house should be surrounded by a proper, sufficiently wide, verandah, and the gauze should be used to *completely close the verandah*, and not for the windows and doors of the rooms. In this way there is far less diminution of the amount of air and light admitted.

I have found from experiments during the past year with different wire gauzes and various species of mosquitos, that not even the smallest kinds of mosquitos will pass through a mesh of 16 to the inch.

This is due to the construction of the legs of the insect.

This fact is of great importance as it allows a far larger meshed wire gauze to be employed than was formerly believed to be necessary. Two or three times as much light and air are admitted, and the expense is reduced. Sandflies pass through the fine 20-hole gauze, so their passage through the 16 hole is not an objection to its use, besides which, sandflies are not everywhere, nor always present, and only the finest muslin will keep out these painful pests.

4. The necessity for incessant vigilance in searching for mosquito breeding grounds near buildings, is well exemplified by the fact that the source of the plague of mosquitos at Onitsha was not discovered for about two years.

At my last visit of inspection there, I found the mosquitos reached the quarters on the hill top *against* the wind. There at no very great distance from the European quarters, the high grass gave them the necessary cover to advance against the wind. The tortuous course of the Nkissi stream, and its shallow flooded areas in the rainy season, no doubt furnish breeding places, but a careful search showed the medical officer that certain old decayed stumps of trees that had long previously been felled, and were hidden in that long grass, contained collections of water in which mosquito larvæ abounded.

5. It is most satisfactory to note the gradual spread of quinine prophylaxis among natives, and the good effects produced thereby.

* * * * *

SIERRA LEONE.

MEDICAL REPORT, 1907.

ANTI-MALARIAL SANITATION.

(Extract.)

The special sanitary measures required under this head were carried out as usual during the year. As these now form a fixed item in the general sanitation of Freetown, they are included in the regular duties of the Sanitary Department of the Corporation. They consist of (1) the general cleaning of streets, open spaces, and surface drains throughout the town; (2) the removal of all refuse and its disposal by burning or dumping into the sea; (3) the collection of old tins, bottles, calabashes, and other old discarded articles likely to act as water holders, and, therefore, breed mosquitos; and (4) the constant inspection of all yards, gardens, and compounds for the purpose of detecting vessels of stagnant water or other artificial breeding places for mosquitos. The actual expenditure incurred on this work by the City Council during the year was £1,137 12s. 7d.

The levelling of the streets and the improvement of the surface drains were continued during the year by the Government, at an expenditure of £1,991 6s. 6d., £642 3s. 4d. of this being expended on the drains.

The canalisation of the watercourses that flow through the town was repaired, where damaged by the floods of the rainy season. These small channels have had a most beneficial result in confining the small amount of water that usually flows in the dry season, and thus preventing the formation of the stagnant pools along the beds of the streams that formerly acted as natural breeding places for mosquitos.

Hill Station with its railway, undoubtedly the finest and the most successful anti-malarial measure ever carried out by any West African Colony, continues its good repute for its almost complete freedom from fever and mosquitos and other insect pests.

The special sanitary gang on duty performed their work satisfactorily, clearing away the bush in the immediate vicinity of the bungalows, cutting down high weeds and grass and sweeping and cleaning the surface drains, &c.

During the year special surface drains were laid down for the conveyance of rain and slop water from each bungalow to a suitable distance on the side of the hill adjoining. In this way the stagnation of water close to the quarters is prevented.

GOLD COAST.

MEDICAL REPORT, 1907.

(Extract.)

Energetic measures have been taken to locate and deal with the breeding places of mosquitos by destroying them when possible, and treating them with kerosine. A large number of holes have been filled in Accra. Endeavours have been made to impress on the natives the importance of destroying mosquito larvæ and limiting breeding possibilities by keeping their premises free from the numerous unconsidered objects, tin pans, &c., which might contain rain water.

WEST INDIES.

BRITISH HONDURAS.

MEDICAL REPORT, 1907.

(Extract.)

Screening Ordinance.—The Screening Ordinance was strictly enforced. Dr. Robertson of the Hospital Marine Service, informed me that he had failed to recognise a single specimen of the *stegomyia fasciata*. By this I do not mean that we were in any way free from mosquitoes, but that we were able to eliminate this special variety. Immediately after this very lengthened dry season, which lasted from 22nd February to 31st May, we had a perfect plague of mosquitoes, but mostly of the benign variety. Professor Stephen well explains this—"that the mosquito if it fails to find water will desist from laying its eggs for an unlimited period until such time as it meets with its natural element wherewithal to do so." Also eggs will last in a dry condition for a considerable time, until it rains, when they immediately hatch out. This fully explains the condition I have mentioned.

BRITISH GUIANA.

MEDICAL REPORT, 1906-7.

(Extract.)

D.—Sale of Quinine at Post Offices.

As one result of the Mortality Commission, arrangements have been made for the sale quinine at District Post Offices, so as to place it within reach of the poorer classes. The drug is retailed at the rate of 2 cents for 30 grains and meets with a ready sale. It is only intended for the benefit of the people; and in order to prevent, as far as possible, its purchase and subsequent re-sale at a profit, the quantity which can be sold to any one person, at a time, has been limited to 180 grains. Later on, as a further precaution, the supplies for this purpose were ordered in tablets coloured pink and stamped with the letters "B.G."

The following hints on the use of quinine were published for general information:—

- "1. Quinine is the only medicine that really cures a person who has malarial fever.
- "2. If taken regularly every week it will, to a great extent, prevent attacks of fever.
- "3. The doses of quinine are roughly as follows:—

"For a child under six months ...	$\frac{1}{4}$ to $\frac{1}{2}$ grain.
"For a child six months to one year	$\frac{1}{2}$ to 1 "
"For a child one year to two years...	1 to $1\frac{1}{2}$ grains.
"For a child two years to five years	$1\frac{1}{2}$ to 3 "
"For a child five years to ten years...	3 to 4 "
"For a child ten years to fifteen years	4 to 5 "
"For over fifteen years	5 "
- "4. Quinine can be obtained at the post offices in country districts at 2 cents for 30 grains.

- "5. Each packet contains 30 grains of quinine, and when divided into six equal parts, each will then contain 5 grains.
- "6. If one of these 5-grain parts is divided into five each will contain a grain, then these can further be divided into equal parts which will give half a grain.
- "7. To prevent attacks of fever, three doses, according to the age, should be taken once a week.
- "8. These hints are only intended as a means of treating and keeping off slight attacks of malarial fever. In severe cases, and especially where children are concerned, a medical man should be consulted."

BAHAMAS.

MEDICAL REPORT, 1907.

(Extract.)

Rules and regulations for the extermination of mosquitoes have been made by the Governor and Executive Council under advice of the Board of Health, and good results are hoped for.

ST. LUCIA.

MEDICAL REPORT, 1907.

(Extract.)

The most important advance in matters sanitary that has happened for some time took place last year, *i.e.*, the enforcing of the Board of Health's additional regulations for the suppression of the *Stegomyia Fasciata* mosquito. Every well in Castries has been filled up or screened with gauze, promiscuous storing of water in kerosine tins, &c., stopped entirely in the town, broken bottles removed from wall tops, drains filled in and graded, &c., &c.; and at the present time very few tanks or barrels remain within a two-mile radius of Castries which have not been efficiently rendered mosquito proof. Those which do remain are being dealt with as fast as possible. The *Stegomyia* is not now commonly seen in the town. On several occasions early in the year, before permanent screening could be pushed, and while Trinidad and Barbados were still infected with yellow fever, the town and suburbs were inspected by parties of men under the Sanitary Inspector to oil all receptacles which could not be overturned or dealt with in a permanent manner. All this business has been ably directed by Staff-Sergeant Ryan, who has also shown considerable ingenuity in adapting some very unpromising water receptacles so as to fulfil the conditions of the regulations. The Board of Health is to be congratulated on these regulations, which place St. Lucia well ahead of her neighbours in sanitation: when in Barbados, for instance, it has been found impossible to induce the Board of Health to frame or pass such by-laws even although yellow fever has existed there for months.

The country districts remain in *statu quo*, except that Roseau seems to be rather worse. The huts are surrounded by rank grass into which garbage is constantly thrown and from which clouds of flies rise when the grass is disturbed: there is a foul, stagnant ditch running through the village, and mosquitoes abound. Something should be done to compel those responsible to improve Roseau.

ST. VINCENT (KINGSTOWN DISTRICT).

MEDICAL REPORT, 1907.

The general sanitary condition of the district was, on the whole, satisfactory. Attempts were made during the year to combat mosquito "breeding-places"; attention being directed to the clearing of yards and drains by the local sanitary authority, and to the removal of broken bottles from walls, &c. The low-lying land at the back of the Paul's Lot portion of the town was inspected, and suggestions made for its proper drainage.

APPENDIX II

REPORT FROM THE ROYAL SOCIETY.

(Received in Colonial Office, 20 January, 1909.)

The conduct of the investigation into the action of drugs upon trypanosomes was referred by the Tropical Diseases Committee to a Sub-Committee consisting of Prof. J. R. Bradford, F.R.S., Colonel Sir David Bruce, F.R.S., Prof. Arthur Cushny, F.R.S., and Mr. H. G. Plimmer. This Sub-Committee entrusted the experimental work of the enquiry to two members of their body, Mr. Plimmer and Prof. Cushny, with such assistance as they might require, and the results of their investigations up to the end of 1908 are embodied in the following reports (numbered I. and II.).

Since the date of the last Report* of the Committee to the Advisory Committee of the Colonial Office, a detailed account of some of these investigations has been published in the Proceedings of the Royal Society (Series B, Nos. 536 and 543).

Since the subjoined reports were received by the Sub-Committee, the experimental investigation has been continued, and further results of value are expected.

JOHN ROSE BRADFORD,
Secretary of the Royal Society.

January, 1909.

Enclosure in Appendix II.

ABSTRACTS OF WORK ON THE EXPERIMENTAL TREATMENT OF TRYPANOSOMIASIS
CARRIED OUT DURING THE PAST YEAR UNDER THE SUPERVISION OF A SUB-
COMMITTEE OF THE ROYAL SOCIETY.

Report No. I.

The following account is an abstract of the continuation of the work of which a short preliminary account was given in the "Report of the Advisory Committee for the Tropical Diseases Research Fund for the year 1907," and is chiefly concerned with experiments made with various antimony compounds upon Nagana and Surra in rats and dogs:—

1. *Further Observations on the Experiments mentioned in the last Report.*

Of the Nagana rats mentioned, which had been treated with atoxyl and mercury (either the succinimide or the perchloride) two lived more than 300 days, five lived more than 200 days, and seven more than 100 days. These were apparently cured, as inoculations from the livers and bone-marrow of seven of them were negative, and of the whole series of rats thus treated only one died from trypanosomiasis, and this one was probably atoxyl-proof.

Of the Nagana and Surra rats treated with sodium antimony tartrate, three are living and well 15 months after inoculation, nine lived for more than 200 days, and nine others considerably more than 100 days. Of those who have died only four have had recurrences; none of them died with any symptoms of trypanosomiasis, and in none were trypanosomes found after death. An emulsion of the liver and of the bone-marrow was injected into other rats from five cases with negative results in each case.

These results are far better than any obtained in our hands with atoxyl.

2. *Results of further Experiments made since the date of the last Report.*

The results obtained by giving the largest possible doses of antimony to rats were not good; the trypanosomes were not driven out more quickly, or more effectually; recurrences were more common, and inflammatory intestinal lesions were present in nearly every case. Two rats died with living trypanosomes in the blood:

* [Cd. 3992], March, 1908.

these two had become antimony-proof, as the later doses did not remove the trypanosomes from the blood, nor make any difference in their number. This strain did not maintain this quality for long, as after the second sub-inoculation from these rats the trypanosomes seemed to have become normal in their behaviour towards antimony.

Sodium antimonyl tartrate, when injected in watery solution into man, produces very severe pain and inflammation in the neighbourhood of the injection, with more or less local necrosis. In order to make the use of antimony practicable in the form of injection, a series of experiments was undertaken, using various other media than water for solution or suspension of the antimony salt. Lanolin, olive oil, and sesamum oil were tried, but the results were not good. Finally, the medium Colonel Lambkin devised, consisting of palmitin and antiseptics, was tried, and found to be practicable.

We have since made further experiments with sterilized olive oil, and as a medium for suspending the metal in a state of extremely fine division (*vide infra*) we have found it easier to work with and much less irritating than Colonel Lambkin's medium.

One great advantage of these preparations is that they can be used upon man with far less difficulties and after-consequences than the watery solutions, which seem to be impracticable; this is of importance should antimony be found of use in human trypanosomiasis.

Sir David Bruce has taken a quantity of lithium antimonyl tartrate (*vide infra*) suspended in this medium with him to Uganda, in order to test its effects upon cases of Sleeping Sickness.

Major Ward, R.A.M.C., has used antimony in this medium on men for other purposes, and he has very kindly placed his notes at our disposal. In one of his cases four doses of $\frac{1}{2}$ grain of sodium antimonyl tartrate, suspended in Colonel Lambkin's medium, were given intramuscularly into the buttock, the intervals between the doses being 3, 4, and 3 days: the doses were then increased to 1 grain, and seven doses of this strength were given, the intervals being 4, 3, 2, 4, 2, and 13 days. In all, this patient had 9 grains of the salt. Major Ward says that "the injections caused a certain amount of tenderness and discomfort at the seat of injection," but that is very different to the effects noticed after the injection of the watery solution.

Major Ward also treated two patients with metallic antimony in a state of extremely fine division suspended in Colonel Lambkin's medium; they were each given one dose of 1 grain, and 11 days afterwards $\frac{1}{2}$ grain. This form caused both pain and discomfort, and also a general increase in the size of the buttock, into which the injection was made, but this subsided without suppuration. This form would appear, however, to be much the more powerful of the two, as the effects obtained from the $1\frac{1}{2}$ grains of the metal were as good and as lasting as those observed in the case in which 9 grains of sodium antimonyl tartrate were given.

Of thirteen Nagana and Surra rats treated with a 5 per cent. suspension of sodium antimonyl tartrate, two have lived more than 100 days, each having had only one dose, three lived more than 50 days, and none have died from trypanosomiasis.

The administration of the metal itself in a state of very fine division has a considerable effect on the trypanosomes; it has a distinctly better effect on Surra than upon Nagana, five Surra rats out of sixteen being alive more than 200 days after inoculation, and four others having lived for a long time. In none of the Surra rats were trypanosomes found at death, whereas in three of the Nagana rats they were present. The metal is more irritating than the tartrate, but the effect is in most cases more prolonged; this is probably due to the fact that the absorption of the metal is much slower. Further, the smaller doses would appear to be the most efficient.

Antimony (metal) and sodium antimonyl tartrate were given before inoculation to test their effects upon the development of the disease; and the metal was found to be far more effective in delaying the appearance of the trypanosomes in the blood than the salt; this is probably due to its slower elimination. One dose of the metal given the day before inoculation delayed the appearance of the trypanosomes until the eleventh day.

This method, if the doses were repeated, might be of some practical value in getting animals safely across dangerous tracts of country, and experiments have been made in order to see whether it would be possible to arrange the treatment with

antimony so that repeated inoculations with trypanosomes should be negative. We have had some success, and the experiments are still in progress.

There are differences in the effects produced by the potassium, sodium, and lithium antimonyl tartrates, if given under similar conditions and dosage. The sodium salt contains, roughly, about 2 per cent. more antimony than the potassium salt, and the lithium salt contains about 2 per cent. more than the sodium; but the doses of the lithium salt have to be much smaller than the corresponding doses of the sodium salt. When the watery solution is injected intramuscularly, it has not caused necrosis of the tissues, but subcutaneously it has occasionally done so. The best strength of solution for rats is 0.25 per cent., and of this 0.5 c.c. has been given for a dose. Out of twelve rats five are alive and well over 200 days after inoculation.

A further series have shown a still greater percentage of cures, for out of fourteen rats treated with four doses of the lithium salt, not one gave a positive result when the blood, liver, and bone-marrow were injected into other rats. This was done at intervals varying from 6 to 27 days after the last dose of antimony. This salt is the most effective of any we have yet tried, and for this reason it was chosen by Sir David Bruce for trial in Uganda.

It was made for the first time for these experiments, and it is much more soluble than either the potassium or sodium compound, which may, perhaps, as well as its greater antimony content, account for its greater effectiveness. It is, however, irritating subcutaneously in watery solution, but apparently not when given intramuscularly.

Experiments have been begun with two new antimony compounds, namely, antimony sodium lactate and antimony sodium calcium lactate, the antimony content being respectively 23 per cent. and 17 per cent. These compounds are not irritating, and the former may possibly be useful, as we have rats which have gone for 2 to 3 months without a recurrence; the latter, however, is too weak a body, as we have had recurrences in every case in which it has been used.

Mixtures of sodium antimonyl tartrate and sodium arsenyl tartrate, and of atoxyl and sodium antimony tartrate, and also potassium antimonate have been tried with no satisfactory results.

In order to see what the effects of antimony would be on the larger and more important animals when suffering from trypanosomiasis, a series of experiments on dogs has been begun. The trypanosome used was that of Surra, which kills dogs of about 20 lb. in weight in approximately 14 days, as this is the trypanosome which is of practical importance with regard to dogs.

They have been treated with the metal in Colonel Lambkin's medium, and with better results when suspended in oil, and with the sodium and lithium antimonyl tartrates. One treated with the metal is living and well nearly 6 months after inoculation; others have lived from 73 to 93 days. At present we have a series of five dogs, now in their third month, which have been treated with an initial dose to clear the trypanosomes out of the peripheral circulation, and then given daily a very small dose of an antimony salt in their drinking water. Their condition is satisfactory, and if this method should succeed, it will be an easy and practical way of dealing with farm animals.

In order to find out in what organs the trypanosomes are latent in rats treated with antimony, eleven rats were inoculated with Nagana, which is less affected by antimony than Surra, and were all treated with four doses of sodium antimonyl tartrate. The rats were killed at various intervals, and the organs selected (the liver and bone-marrow) were made into an emulsion with a minimum quantity of 0.75 per cent. salt solution, and injected into other rats in doses of 1 c.c.; the same dose of blood from the heart was also given. In four the results were entirely negative; in three trypanosomes were found in the liver, and in six in the bone-marrow. It would appear that the bone-marrow is the place where the trypanosomes can live longest, and that the liver is also a place where they can find protection. This is borne out by some experiments we have made upon trypanosomiasis in birds, in which cultivations of trypanosomes can often be made from the bone-marrow when they cannot be made either from the organs or the blood.

In another series of fourteen rats (mentioned above) which were treated with lithium antimonyl tartrate the results were entirely negative.

Experiments have been carried out with a view of throwing light on the more exact nature of the changes which are produced in trypanosomes when they are

brought into contact with trypanocidal substances. The general principles we have observed in these experiments have been: (1) The preparation of an isotonic solution of the substance with which the experiment is to be made, so that when it is added to the blood containing the trypanosomes, neither osmosis, nor hæmolysis will occur in the cellular elements contained in the blood; (2) To use always equal volumes of the solution and the affected blood; (3) To use blood at the time when the trypanosomes are becoming very numerous, so as to avoid the presence of old, feebly moving forms, which are always present in the later stages of an acute infection. The method of observation has been to watch the behaviour of the trypanosomes when in contact with the solution of the drug under the microscope. A measured drop of blood and of solution are mixed on a slide with care; the mixed drop is then covered with a sufficiently large cover-glass, and this is sealed with vaseline.

It has been found possible in this way to exactly determine the dilutions at which the various drugs used cease to have an instantaneously trypanocidal action; further, in higher dilutions, by carefully watching the changes taking place in the trypanosomes, it is possible to determine the dilution at which no effect is produced, and between these two points the periods of time necessary to ensure immobility and death of the trypanosomes can be ascertained.

By a comparison of the results obtained, a very good estimate of the probable action of the drug when given to an affected animal can be arrived at. For instance, sodium and lithium antimonyl tartrates were found to act, in the same dilutions, in a manner fairly comparable to their action on the trypanosomes in an affected animal, and with atoxyl a much higher concentration of the drug was necessary in order to obtain the same destruction pictures, results corresponding with the rapidity of the disappearance of trypanosomes from the peripheral blood of affected animals when treated with the above drugs.

In the case of the two new lactates mentioned above, their probable therapeutical value was accurately foretold by a preliminary study of their action *in vitro* in the above manner.

In all these experiments controls have been carried out; it has been found that trypanosomes will live and retain their activity for hours when infected blood and the diluting fluid alone are mixed together.

The various changes taking place in trypanosomes coming into contact with a dilute trypanocidal drug, commencing with their preliminary extraordinary increase of activity and their subsequent swelling up, immobility, and disintegration, can be watched in all their different stages in this manner.

These experiments show that of all the substances we have used, antimony in a state of finest division, and lithium antimonyl tartrate have the most powerful trypanocidal action, so that we are directing our present work principally on these bodies. We have found that the metal, although its effects are more prolonged than those of any other substance we have tried, also acts fairly quickly, as both Nagana and Surra trypanosomes are completely driven out of the peripheral blood in from $1\frac{1}{2}$ to $2\frac{1}{2}$ hours after a dose.

Captain Bateman, R.A.M.C., who assisted me during the first 9 months of the year, was selected by Sir David Bruce to accompany him to Uganda, and his place has been taken by Captain W. B. Fry, R.A.M.C.

A paper embodying the details of the experiments made up to August 20 has been published in the "Proceedings of the Royal Society," B, Vol. 80.

December 2, 1908.

H. G. PLIMMER.

Report No. II.

The near chemical and pharmacological relation of arsenic and antimony suggested naturally the use of the latter in a disease in which the former had proved of value; but the irritant action of the ordinary antimony salts seemed to preclude their use by hypodermic injection. After repeated attempts to form organic compounds of antimony analogous to atoxyl, one of us (C.) submitted to Plimmer and Thomson, for experimental trial, a compound of glycine and antimony, and their experiments showed that antimony possesses certain trypanocidal properties. This first antimony compound proved difficult to make and unstable, however, and these observers substituted for it tartar emetic; the results were satisfactory, and the following investigation was undertaken with the object of

determining the limits of usefulness of other antimony compounds in these diseases. The experiments were made on rats infected with a strain of Nagana (*T. brucei*) obtained by the kindness of Sir J. McFadyean. This strain was fatal to rats within 6 days after inoculation, or within 3 days after trypanosomes appeared in the blood. The inoculation and treatment were carried out at the Lister Institute of Preventive Medicine.

In the use of the heavy metals it is generally recognized that the more readily dissociated compounds are liable to cause more local irritation than others, and where the local action is to be avoided, attempts are made to use compounds which are less immediately dissociated and pass into the general tissues in their original form there to free the metallic ion compound which is necessary for the desired effect.

An example of this is offered in the substitution of atoxyl for the older arsenic preparations in the treatment of trypanosomiasis, for there is no question that the atoxyl owes its activity to the simpler compounds formed from it in the tissues. It is possible that, in addition to avoiding local irritation, such compounds as atoxyl may penetrate cells which are not permeable by ordinary arsenic salts, and that the latter may in this way be liberated in cells to which they would not otherwise have had access.

With this in mind it seemed desirable to test the action of compounds in which antimony is more firmly combined than the ordinary salts, but very few organic combinations are available, and we have succeeded in obtaining only two such for investigation. Of these the first was tetra-ethyl-stibonium iodide ($(C_2H_5)_4SbI$) which was injected into seven Nagana rats in quantities up to 20 mg., but had no effect whatever on the parasites, the injected animals dying at the usual time, and the blood being found to be swarming with trypanosomes. The other, diphenyl-stibinchloride ($(C_6H_5)_2SbCl_3, H_2O$) was kindly put at our disposal by Prof. A. Michaelis, of Rostock, but proved quite devoid of action in quantities of 4 cc. of a saturated solution in sodium carbonate, in which it is more soluble than in water. These compounds appear non-irritant, but the antimony is probably not freed in the tissues, the first compound in particular resembling the ammonium salts which pass through the animal body without freeing nitrogen.

These compounds proving valueless for our purpose, it was determined to find in what form the antimony ion had to be freed to be effective, and a number of compounds commercially obtainable were tested. Of these the potassium metantimoniate (SbO_2OK), injected in quantities up to 30 mgs., scarcely affected the trypanosomes in the blood; doses above 30 mgs. were followed by the disappearance of the parasites from the circulation, but the rats became very ill and died within a few days, and *post mortem* enteritis and nephritis were found to have been developed. A preparation of antimony oxide (Sb_2O_3), stated to be in colloidal form, was obtained from Kalle & Co., but proved extremely irritating, and had a very low efficiency. The preparation contained 4.5 per cent. of antimony oxide only, and in quantities corresponding to 4 mgs. of the oxide had little, if any, effect in reducing the number of trypanosomes in the blood; 8 mgs. caused their disappearance, but they recurred on the fourth day.

In the former of these preparations antimony is presented in pentavalent, in the latter in trivalent, form, and both are equally inefficient, while in the forms in which it is presented in combination with organic acids it is also in trivalent form but has been shown to have a high degree of activity. It is possible that, given in the colloid form, it is deposited locally and fails to reach the trypanosomes. This would also explain the intense local action which was more marked from this than from any other preparation.

A glyceride of antimony, analogous to boroglyceride, was formed by heating glycerine with the oxide, and proved fairly effective in destroying the trypanosomes in the rats, but it was very irritant and caused hæmoglobinuria, and the solution in glycerine tended to deposit the oxide when diluted.

A few experiments were made with Schlippe's salt, sodium sulphantimonate ($(NaS)_3SbS$): it destroyed the trypanosomes in the rat very satisfactorily (see Table I), but induced very considerable local reaction, and therefore appears to be precluded from use in therapeutics. This result agrees with that obtained by Broden and Rodhain* in man.

* Arch. f. Schiff-ind. Tropenhygiene, XII, Heft 14, 1908.

TABLE I.

Summary of Results of Treatment with Schlippe's Salt.

I.	II.	III.	IV.
Number of rats treated.	Number of rats that died without recurrence, but before any deduction could be made.	Number of rats surviving over one month after cessation of treatment without recurrence.	Number of rats in which recurrence occurred.
20	6	3	11

Of the rats included in Column III.—

1 survived 39 days; 1 survived 33 days; and 1 survived 76 days.

The cause of death could in no case be attributed to the disease or its treatment.

Of the rats included in Column IV.—

Recurrence took place in 10, 21, 9, 10, 10, 13, 7, 13, 16, and 14 days, and all died within 2 weeks of cessation of treatment of the recurrence (or of the last recurrence, for many had more than one recurrence) with the exception of one which is still alive and well 244 days after cessation of treatment of the recurrence—the latter by another drug (sodium antimony tartrate.)

In Schlippe's salt and in the glyceride, antimony is pentavalent, and these were efficient trypanocides, especially the former, while the metantimonate, where antimony is also pentavalent, possessed a low efficiency.

The sulphantimoniate differs from the metantimoniate in its great instability, and it seems probable that the marked local reaction arising from it is due in great part to its being decomposed at the point of injection with the deposit of the insoluble antimony sulphide Sb_2S_3 , which produces a slow lasting reaction. Enough reaches the general tissues, however, to react with the parasites, and here its instability permitting of its forming new compounds renders it peculiarly active. The metantimoniate, on the other hand, is much more stable, and probably fails to be reduced to the trivalent form.

The greater number of our experiments were done with the combinations of antimony with the organic acids corresponding to the ordinary tartar emetic. Among these the best combinations were found to be those with oxyacids of the fatty series, those of the aromatic series proving much less soluble. Among the salts examined were the lactate, citrate, malate, and mucate, the results of which were compared with those obtained by the tartrate.

They were formed by boiling antimony oxide with the acids, and subsequently neutralising with sodium hydrate, or sometimes by forming the acid sodium salt, and boiling it with freshly prepared antimony oxide. The mucate, which was investigated with the idea that its multiple hydroxyl groups might prove to have special powers of retaining antimony in solution, may be dismissed, as, though powerfully trypanocidal, it induced very great local irritation. The citrate seemed to be inferior to the malates and tartrates, which were approximately equal in value.

Summary of Results of Treatment with Sodium Antimonyl Malate.

I.	II.	III.	IV.
Number of rats treated.	Number of rats that died without recurrence, but before any deduction could be made.	Number of rats surviving one month after cessation of treatment without recurrence.	Number of rats in which recurrence occurred.
23	9	5	9

Of the rats included in Column III.—

1 survived 241 days; 1 survived 113 days; 1 survived 115 days; 1 survived

66 days; and 1 is still alive and well, 235 days since cessation of treatment.

Of the rats included in Column IV.—

Recurrence took place in 12, 11, 7, 17, 5, 11, 9, 36, and 10 days, and all died within 2 weeks of cessation of treatment of recurrence (or of the last recurrence), except one which lived 231 days after cessation of treatment of the recurrence by another drug (Schlippe's salt).

Among the tartrates and malates, the sodium and potassium salts were equally efficient trypanocides, and there was no appreciable difference in their local effects, but the substitution of an alkyl radicle for the potassium or sodium of the salt seemed to be attended with some advantage. Solutions of ethyl-antimonyl tartrate were kindly prepared for us by Prof. Collie by heating freshly precipitated antimony oxide with ethyl tartrate, to about 150° C. in sealed tubes. The solutions are distinctly acid, but can be neutralized or rendered slightly alkaline with ammonia, and can be sterilized by boiling without any cloudiness resulting. It is a very efficient trypanocide and causes no local irritation in the rat. After the injection of 1 cc. of a 0.2 per cent. solution* into rats of 100-200 grammes weight, trypanosomes, though previously numerous, entirely disappear from the peripheral blood within 1 to 2 hours. Estimated by the amount of antimony present in the solutions, the ethyl is more powerfully trypanocidal than the sodium salt, which may suggest either that less is deposited at the point of application, or that it reaches the trypanosomes in a more readily penetrating form.

Though more poisonous to the rat than sodium-antimonyl tartrate, the *range* of dose, or the difference between the effective trypanocidal dose and the lethal dose, is not less than that of the other antimony preparations. The optimum dose may be found to correspond to Browning's therapeutic dose, viz.: two-thirds of the maximum dose that average animals tolerate.

From our own work, and that of others, we think that sufficient data have been obtained to indicate some points which must be taken into consideration in attempting further advance in the treatment of trypanosomiasis:—

- (1) As regards the compound, it must be non-irritant, and capable of remaining in perfect solution at the temperature and alkalinity of the tissues.
- (2) It must act quickly on the trypanosomes, for otherwise these parasites seem to acquire a tolerance to it. It is possible that some drugs may require to be altered in the tissues before they begin to affect the parasites, but with this proviso, we suggest as a working rule, that no drug which, given in full therapeutic dose, does not destroy the trypanosomes in the blood within 2 hours is likely to prove an advance on remedies already in use.
- (3) When the trypanosomes have been expelled from the blood by a single full therapeutic dose, there must be no recurrence in the majority of cases within some fixed time which will vary with the particular host, and the species and strain of trypanosome in use; the length of this period must be determined by each investigator by reference to some of the known trypanocides. In our experiments it proved waste of time to persevere with any drug whose administration in a single full dose was followed by a recurrence in the majority of cases within a week. The longer the time during which there is no recurrence in the majority of animals treated the more promising is the outlook for the drug under trial. But the non-recurrence in a single individual is of comparatively small importance.

In our experiments the majority of the rats that survived the injection for three weeks showed recurrence within that time whatever the preparations used.

In the recent report† from Uganda, the conclusion is drawn that the medicinal treatment pursued up to that time had proved of little lasting benefit in the great majority of even the early cases of Sleeping Sickness. From this it seems a fair inference that remedies which suffice to change an acute trypanosomiasis into a more chronic form may ameliorate symptoms, but do not necessarily greatly prolong

* The strength of the solution was ascertained by estimation of the antimony.

† Quarterly Report on the Progress of Segregation Camps and Medical Treatment of Sleeping Sickness in Uganda (Quarter December 1, 1907, to February 29, 1908).

the natural course of a chronic infection such as Sleeping Sickness. In seeking for a remedy for the chronic condition, by experiments with acute infections, nothing short of an immediate and complete disinfection should be the object, and it is with this view that we venture to suggest the foregoing considerations.

Applying these principles to the ethyl antimony compound, it appears to comply with the first fairly satisfactorily. It expelled the trypanosomes from the blood within two hours. As regards recurrence after a single full dose, we have under observation thirteen rats of which six have shown a recurrence, on the 14th, 16th, 16th, 22nd, 26th, and 29th day. There has been no recurrence in the seven others up to date:—

In 1 up to the 30th day after treatment.

„ 3	„	29th	„	„
„ 1	„	25th	„	„
„ 2	„	22nd	„	„

We quite recognize that these intervals are too short to admit of any definite conclusions being drawn, but we have not found any drug which has given equal results in the same time; and even if this preparation should fulfil its promise in our experiments, it will be necessary to test it against other species and strains, and in different hosts before any general statement as to its usefulness can be made.

We have under observation some rats treated with a solution combining the best of the arsenical and antimonial trypanocides at present known to us, viz.: ethyl-antimonyl tartrate and atoxyl. On the theory advanced by Ehrlich the combination should be a good one, but until more time has elapsed no statement can be made as to whether the combination will prove more efficient in practice than the ethyl-antimonyl tartrate alone.

APPENDIX III.

UNIVERSITY OF LONDON.

REPORT OF PROFESSOR OF PROTOZOOLOGY for the Year ending June 30th, 1908.

At the beginning of August, 1907, I attended the meeting of the British Medical Association at Exeter and opened a discussion upon “The Hæmoflagellates” before the section of Tropical Diseases. In the last week of the same month I went to Mr. Gurney’s laboratory on Sutton Broad, Norfolk, with the principal object of studying the blood-parasites of freshwater fishes. During the remainder of the year covered by this report I worked at the Lister Institute.

I will report on the work of the year under two headings:—I. Research; II. Teaching.

I. *Research*.—In my work I have been occupied chiefly with investigations upon trypanosomes. These parasites are of the utmost importance as the cause of sleeping sickness in man and various diseases in domestic and other animals. They have, therefore, been the object of much research, and the subjects of a vast number of memoirs by medical men and naturalists in all parts of the world. These researches may be divided conveniently into two principal lines: (*a*) investigations into the natural history and life-cycle of trypanosomes, with the special object of discovering their mode of transmission from one host to another, as a basis for devising measures to check the spread of infection, and so to prevent and guard against the diseases caused by them; (*b*) experimental studies upon the action of drugs and treatment upon trypanosomes in the blood, and upon animals infected by them, as a basis for the therapeutics and cure of diseases caused by trypanosomes.

The therapeutics of trypanosomiasis is a purely medical subject, and one that only a medical man could deal with satisfactorily. Much work on these lines has been carried on by my assistant, Dr. J. D. Thomson, who has furnished me with a report on his work which I append.

My own investigations have been directed entirely towards the elucidation of the problems connected with the life-history of trypanosomes, and the mode of transmission of these parasites. This is a subject on which very little definite is known, and on which the opinions of authorities are greatly at variance; there is, in fact,

scarcely any question of natural history (for such the problem is at bottom) which is in such a confused and chaotic state.

I may recall the fact that in my report for the year ending June 30th, 1907, I stated that I had been occupied chiefly during the year in working out my material collected in Uganda in the year 1905, when, as Special Commissioner of the Royal Society, I was engaged in studies on the transmission of *Trypanosoma gambiense*, the parasite of sleeping sickness, by the tsetse fly, *Glossina palpalis*, at Entebbe. During my stay at the Sutton Broad Laboratory I finished writing up my account of this work. My complete memoir was sent to press in October, 1907, and was published in the Quarterly Journal of Microscopic Science for March, 1908; in it the following conclusions or opinions were expressed by me as the result of my work:—

- (1) In Uganda *Trypanosoma gambiense* begins, but does not complete, a developmental cycle in *Glossina palpalis*, the method of transmission by this fly being purely mechanical and direct.
- (2) In other diptera also *T. gambiense* starts on a development in a precisely similar manner, but without getting so far, or persisting so long, as in *Glossina palpalis*.
- (3) The observations of Koch, Stuhlmann, and others, show that *T. brucei* (the parasite causing "nagana" disease in cattle) goes through a developmental cycle in *G. fusca*.
- (4) It is probable that *T. gambiense* has an invertebrate host in which it completes its life-cycle in regions where it is indigenous, and it is possible that the true host may be *Glossina fusca*.
- (5) Considerations of phylogeny indicate that the life-cycles of different trypanosomes should not be expected to be in all cases of one invariable type.
- (6) The encystation observed in *T. grayi* (a species of trypanosome found occurring naturally in *Glossina palpalis*) indicates that contaminative infection may occur as well as inoculative.

In order to complete and extend my results I greatly wished to go to Uganda again. Dr. Thomson was willing to accompany me, and I reckoned the sum required for the two of us, for travelling expenses and maintenance for six months, at £600. Our scheme was to leave England in September, 1907, and return at the end of April, 1908, in time for my summer course of lectures. I applied to the Royal Society for the sum required, but they were not able to give me more than £300, and the suggestion was made to me that I should go out alone. I applied elsewhere for the remaining £300, but was not able to obtain it. I was reluctantly obliged therefore to abandon all thoughts of the expedition, as it seemed to me hardly worth while to undertake an investigation of the kind single-handed and without medical assistance not being a medical man myself.

Being unable to continue my work on sleeping sickness, I decided to attack the problem of trypanosome development here in England. Many British animals are found to be infected commonly in nature with species of trypanosomes peculiar to them. The common sewer rat in London is frequently found to be infected with *Trypanosoma lewisi*, and other species of trypanosomes are found in fishes and birds. It is very important to attack the problem of trypanosome development and transmission as it occurs in nature, in non-pathogenic species of these parasites. My assistant, Dr. Woodcock, whose report is appended, has taken up the study of the trypanosomes of birds. I have occupied myself with the trypanosomes of fishes, and, with the assistance of Dr. Thomson, I have been carrying on studies on *T. lewisi*.

At Sutton Broad I was successful in finding trypanosomes commonly in the perch, bream, tench, and pike, and also trypanoplasms in the three last-named fish. During the short period (three weeks) that I was at the laboratory, however, I was not able to do more than survey the ground, so to speak, and to make preparations of these parasites for further study and for demonstration in connection with my lectures. I hope to return to the subject in later reports. I was also fortunate in having at my disposal a stock of goldfish, all apparently infected with trypanosomes, in a pond in the grounds of the Lister Institute at Queensberry Lodge, Elstree, while, on the other hand, in another pond standing in the grounds of a gentleman living near Elstree, the goldfish are all free from infection. Attempts were made to infect goldfish from the second pond by inoculation of blood of infected goldfish from the first pond; but the experiments gave negative results.

With regard to *Trypanosoma lewisi* of the common rat, I desire to investigate its complete life-history, first in the blood of the rat, secondly, in its passage from one rat to another. It must be borne in mind that in all these studies the investigator is dependent largely on material preserved and stained by modern methods of technique, since very little can be made out by the study of the living parasite alone. But all methods of technique deform the minute structure of the parasite to a greater or less extent. It seemed to me very important, therefore, to commence by a careful investigation of the action of different methods used in modern technique, and to institute a rigorous comparison of their effects; in carrying out this investigation, an insight is obtained at the same time into the minute structure of the trypanosomes, and it becomes possible to eliminate or discount false appearances due to inherent defects in the technique. During a great part of the year covered by this report, I have been engaged in an investigation on the effect of methods of technique upon *T. lewisi*. Such an investigation is very laborious, since, after making the preparations, an accurate comparison of the results can only be instituted by drawing a number of the trypanosomes carefully to scale with a camera lucida at a magnification of not less than 3,000 linear. Work of this kind is very trying to the eyesight, and cannot be continued with safety for more than a certain number of hours a day. I have trained a talented lady, Miss Rhodes, to help me in my drawing, but have at present no funds to pay her for the work except my private income. I have already obtained some very important and interesting results, which I hope soon to publish.

With regard to the transmission of the trypanosome of the rat, it is generally supposed to be effected by one of the two external parasites of the rat, namely, the rat-flea and the rat-louse. Prowazek has described a developmental cycle in the louse, but was unable to obtain experimental evidence of the transmission being effected by the louse. Rabinowitsch and Kempner, on the other hand, obtained experimental evidence of transmission by the flea, but no developmental stages of the trypanosome in the flea have as yet been described, so far as I am aware.

I was able to obtain vast numbers of the rat-louse, and to make some experiments and observations with it. Lice were taken from an infected rat and divided into three lots. Some of the first lot were dissected at once, and were found to contain living trypanosomes, of which preparations and drawings were made. The remainder of the first lot of lice were then put on to a healthy rat; but it never became infected. The second lot of lice were kept twenty-four hours, and then some of them were dissected and were all found to contain living trypanosomes, which were preserved and studied. The remainder of the second lot of lice were then put on to a second healthy rat, but it also never became infected. The third lot of lice were kept forty-eight hours; by this time most of them were dead, but some were still active; some of the living lice were dissected and were found in all cases to contain living trypanosomes of which preparations and drawings were made. The remainder of the third lot of lice, about a dozen living, were put on to a third healthy rat, but this rat also never became infected. The fæces of lice living on an infected rat were also carefully collected and mixed with the food given to healthy rats, but without results. Thus my experiments seem to show that the infection is not transmitted by lice, and it is necessary to look for the source of transmission elsewhere. I tried mixing fæces of infected rats with the food given to healthy rats, but no infection resulted.

I was unsuccessful at first in obtaining living rat-fleas. I examined a great number of freshly caught wild rats very carefully without finding a single flea. The rat-flea does not live permanently on the rat, but haunts its burrows, and only springs on to the rat when it is hungry, leaving it again when satiated. I offered the professional rat-catchers, or anyone else whom it might concern, a shilling apiece for fleas, but not one was brought to me. Hence my investigations received a check, but I am happy to state that I am at present receiving a steady supply of rat-fleas from the caretaker of the Sutton Broad Laboratory to whom I paid, for the first thirty, the price stated above; I have now reduced the price to sixpence a flea. I am trying to breed these precious animals, and hope to establish a good stock for future experimental work.

In addition to studies upon trypanosomes, I have been engaged upon several investigations of minor extent.

Lieutenant-Colonel Wyville Thomson, I.M.S., kindly sent me from Kasauli,

India, some slides of the blood of the Himalayan rock-lizard containing hæmogregarines. A great many species of these interesting blood-parasites are now known, chiefly from reptiles and amphibia; a few are known also from mammalian hosts, and Dr. Thomson is studying one from the rat. Next to nothing is known, however, of the development of hæmogregarines in the invertebrate hosts which transmit them, a gap in our knowledge which it is very desirable to fill. The species sent to me occurs in a lizard which is very common in the neighbourhood of the Central Research Institute at Kasauli, and would, therefore, be a very suitable form for further study. I have, therefore, published, in the proceedings of the Zoological Society, a detailed description of this parasite from the slides sent to me, mainly with the object of drawing attention to its existence.

Dr. Turnbull, of the London Hospital, handed over to me some material consisting of internal organs of sea-trout, which were observed to be dying in great numbers of an unknown disease in the River Ewe in Ross-shire. Dr. Turnbull being on his holiday at the time when he collected the material, had no better means of preserving the tissues of the fish than putting pieces into methylated spirit. He made, however, a number of valuable observations on the condition of the organs so far as it could be determined by simple inspection in a post-mortem dissection of the fishes, and he very kindly handed over to me all his notes and material, including some sections cut by him at the London Hospital. The preservation of the material left much to be desired, but I was able without difficulty to recognize the presence in all the tissues of great numbers of a parasite belonging to the genus *Ichthyosporidium* (order Haplosporidia). Several species of this genus of parasites have been described from various kinds of fishes, but none of them are known to have such lethal powers as the species discovered by Dr. Turnbull. I have made a number of drawings and microphotographs of the material in my possession, and I hope to pursue the investigation further when opportunity offers. It would be very interesting and important to discover the manner in which the fish become infected with these parasites, a subject upon which nothing whatever is known; but such investigations could only be conducted on the spot with living material.

Dr. J. Burton Cleland, of the Public Health Department, Perth, Western Australia, sent me a number of interesting slides of parasitic protozoa from Australia. Amongst these I may mention specially some preparations of the blood of a snake, showing hæmogregarines present, and some smears of a fish, the "Milky Barracouta" (*Thyrsites atun*), which proved to be infected with a Myxosporidian parasite, a species of *Chloromyxum*. Myxosporidia are very common parasites of fishes and frequently have very fatal effects on their hosts. Very devastating epidemics have often been caused by them; for instance, amongst carp and barbel in German rivers, and amongst fishes in the lakes of North America. These parasites, therefore, have considerable economic importance. I learn from Dr. Cleland that the parasite of the Milky Barracouta also has very deadly effects on the fish. The material that Dr. Cleland sent me was inadequate for a thorough study of the parasite, but at the time I am writing I have received from him a further consignment of material, consisting of diseased tissues of the fish preserved according to my directions, and my friend, Dr. D. J. Reid, is now engaged with me in studying this material.

Captain R. McCarrison, I.M.S., sent me from Gilgit specimens of human fæces, in order to ask my opinion on the nature of certain bodies observed by him to be present, and which he at first thought might be eggs of some parasite. I made microscopic preparations of the fæces, and found that the bodies in question were amœbæ, agreeing closely with Schaudinn's description of *Amœba coli*, especially in the fact that they most frequently possess eight nuclei. I made a number of drawings of these parasites; they occur also with only one nucleus, or with any number up to eight and sometimes, but rarely, with more than eight nuclei. Captain McCarrison sent me afterwards more material of this parasite, upon which I reported further to him. He is now, at the time of writing, in England, and as soon as he is free from certain examinations with which he is saddled, he hopes to continue his investigations upon his material of these amœbæ in my laboratory. He believes these parasites to have a medical and etiological significance, which I am not at liberty to discuss.

As will be evident from the foregoing, a great deal of my time is taken up with what I may call consultative work, which chiefly consists of examining, and giving an opinion on, material sent to me or brought to me. This work entails also con-

siderable correspondence, or, it may be, lengthy interviews. I do not, however, grudge in any way the time spent in this manner, as I derive much instruction from it myself, and by encouraging others to research I am enabled to further what I regard as the object of my chair, namely, the advancement of the science of protozoology.

II. *Teaching Work*.—This may be divided into (1) my formal course of lectures, and (2) informal instruction given by me at any time to people working in my laboratory, that is to say, advice as to the most profitable course to pursue in their investigations or instruction in technique and methods of research.

(1) I give my formal course of lectures always in the summer term, during the months of May and June. I chose this time for two reasons; first, because medical men stationed in the tropics are more likely to be at home on leave at that time of the year, and this class of practitioner is most likely to require such instruction as my course provides; secondly, because in the summer months it is much easier than at any other time to procure protozoa of all kinds for demonstration at my lectures. A further advantage is that the evenings are longer and microscopes can be used without artificial light up to, or even after, 7 p.m. My lectures are given at 5 p.m., and are followed by demonstration of specimens.

I propose to give general and special courses of lectures on alternate years. In 1907 I gave a general course of lectures on the protozoa, covering the whole group. In 1908, therefore, I gave a special course on hæmoflagellates, giving a detailed and critical account of all that was known on the development and transmission of trypanosomes and allied organisms. In 1909 I hope to give a general course again.

My course on hæmoflagellates extended to thirteen lectures, and was well attended; 37 came to the opening lecture, amongst them Sir David Bruce and other medical men.

(2) Informal instruction has been given by me to several gentlemen working in my laboratory.

Captain Hamerton, R.A.M.C., worked in my laboratory for about three months, his object being to acquire experience of methods for studying tsetse flies and trypanosomes, as a preparation for the expedition to Uganda on which he has now started with Sir David Bruce for the study of sleeping sickness problems. Captain Hamerton occupied himself first with the study of the anatomy and histology of the tsetse fly (*Glossina palpalis*), utilising material collected, and preparations made by me in Uganda. He then studied methods of preserving and staining trypanosomes, a study upon which, as stated above, I was myself engaged. Captain Hamerton also attended all my lectures and demonstrations.

Dr. H. S. Fremlin, of the Government Lymph Laboratories, has occupied a place in my laboratory, and has put in as much time as he could spare from his official duties in carrying on studies upon protozoa generally, his principal object being to acquire a knowledge of methods and technique.

Dr. D. J. Reid has occupied a place in the laboratory and has been occupied in various studies on protozoa and on cancer. He has made microphotography his speciality, and has rendered much assistance to other workers.

Dr. A. G. Bagshawe, who has now been appointed Director of the Sleeping Sickness Bureau, also did some occasional work on trypanosomes in my laboratory, chiefly in connection with the study of technique.

Appended will be found reports by my assistants, Dr. J. D. Thomson and Dr. H. M. Woodcock, and a list of works published from my laboratory during the year covered by this report. Dr. Thomson has been occupied chiefly with studies upon the leucocytozoon of the rat, and upon the curative treatment of animals infected with lethal trypanosomes. Dr. Woodcock has taken up as his principal research the study of the life-history and transformations of the protozoan blood-parasites of birds.

E. A. MINCHIN.

Lister Institute,
23rd November, 1908.

Appendix I.

REPORT of Dr. J. D. THOMSON, M.A., M.B., C.M., Assistant to the Professor of Protozoology, for the year ending June 30th, 1908.

During the year ended 30th June, 1908, in addition to assisting in the general work of the laboratories and to preparing a few of the slides (mostly pathogenic trypanosomes) for the protozoological cabinet, I was engaged in research. This research work may be divided into three sections: (1) Investigations connected with the experimental treatment of trypanosomiasis; (2) Studies on the life-history of the trypanosome of the common rat; and (3) Studies on the life-history of another blood-parasite of the common rat—a leucocytozoon found in the mononuclear white blood corpuscles.

(1) The first of these researches—the experimental treatment of trypanosomiasis in rats—was undertaken, to begin with, in collaboration with Dr. Plimmer, F.L.S., under the direction of the Tropical Diseases Committee of the Royal Society. The first part of the work was concerned chiefly with drugs already reported on by other investigators, and the results were summarized in a note to the Committee, and were communicated by Sir Ray Lankester, K.C.B., F.R.S., to the Royal Society and appeared in the published Proceedings (1907). This was followed by further experiments in the treatment of trypanosomiasis in rats, and during this period the value of certain compounds of antimony, more especially of tartar emetic (*potassium antimonyl tartrate*) and of sodium antimonyl tartrate, was discovered. During this period most of the experiments were done with sodium antimonyl tartrate. A paper embodying these further results was communicated by Sir Ray Lankester, K.C.B., F.R.S., to the Royal Society and appeared in the Proceedings (1908). At the end of November, 1907, some re-arrangements were made in the carrying on of this work for the Tropical Diseases Committee of the Royal Society, and since that date I have continued this investigation in collaboration with Professor Cushny, F.R.S., who, as a member of the Committee, had all along given advice on pharmacological matters. Solutions of the antimony tartrates when given hypodermically cause very little irritation to the tissues of the rat; but when a solution of sodium antimonyl tartrate was tried on man, it caused much pain and swelling, and in one case sloughing of the subcutaneous tissues at the site of injection. For this reason its use in the treatment of trypanosomiasis in man is greatly restricted. Hypodermically it is inadmissible. It can be given by the mouth, but its action on the trypanosomes when exhibited in this way has not yet been determined. It has, I believe, been given intravenously; but whether it will be practicable or not to employ it in this way remains to be seen. Again, although as trypanocides these potassium and sodium antimonyl tartrates act more powerfully than atoxyl—the most efficient trypanocide hitherto known—other compounds of antimony may be found which are more powerful still. In continuing these investigations then we have a two-fold object in view: (*a*) to try to find a compound of antimony that will be more powerful as a trypanocide and less irritating to the tissues of the host than those already named, and (*b*) to determine, if possible, the limit of usefulness of antimony in the treatment of sleeping sickness. We hope to submit a report on this investigation to the Tropical Diseases Committee of the Royal Society at a future date.

(2) Studies on the life-history of *Trypanosoma lewisi*—the trypanosome of the common rat. In these studies I have assisted Professor Minchin and, as he has already reported thereon, I may pass them over.

(3) Studies on the life-history of a Leucocytozoon found in the mononuclear leucocytes of the common grey rat (*Mus decumanus*). I first saw this parasite in the mononuclear corpuscles of the rat when examining films for *T. lewisi*. It had previously been referred to by Balfour at Khartoum. After I had worked at it for some time, I learned from Dr. Stevenson, of University College, that he too had observed the same parasite in blood-smears from a London sewer-rat. Dr. Stevenson and I then arranged to collaborate in the study of the life-history of this parasite. Attempts to convey the infection from infected to uninfected rats by the injection of blood, and of the juices of various organs and of bone marrow, have hitherto failed. All experiments on these lines proved entirely negative. Dr. Stevenson is at present in Cairo, and I do not feel at liberty to write about the work accomplished more than to say that we have observed some interesting changes that the parasite undergoes in the stomach of the rat-louse, which point to a necessary cycle

in an invertebrate host. If this cycle is not completed in the louse, it may be completed in some other parasite of the rat—possibly in the flea. Lice put on to an uninfected rat after they had fed on an infected one failed to convey the infection. All the lice kept for examination after they had fed on the infected rat were found to contain the parasite. I am studying this parasite because I believe that a knowledge of its life-history would fill an important gap in blood-parasitology; and because such knowledge may throw some light (important even if it were but a side-light) on some human diseases of which we at present know little beyond the fact that they are due to protozoa (*e.g.*, Kala-Azar), and perhaps on others of which as yet we do not know even that much. Leucocytozoa, besides occurring in the common grey rat, have been found in the dog, in the Indian palm-squirrel, and in an Indian hare, but as yet very little is known about their life-history. So far, no leucocytozoon has been found in man; but the Leishman-Donovan parasite (the parasite of Kala-Azar) has been found in macrophages and in mononuclear leucocytes in the blood of man. Hitherto, medical interest in blood-parasites belonging to the protozoa has chiefly been centred in those that inhabit the red cells (*e.g.*, those of malaria in man and of the piroplasmoses in cattle, &c.), and in those that are free in the plasma (*e.g.*, the pathogenic trypanosomes—those, *viz.*, of sleeping sickness in man and of nagana, surra, &c., in domestic animals). In the future, more attention may be paid to parasites capable of attacking leucocytes. When it is remembered that leucocytes are not only carried like red cells passively to all parts of the blood vascular system, but that unlike red cells they, as the name “wandering cell” implies, have the power to leave the finer vessels and capillaries and invade the organs and tissues proper, the study of their parasites seems worth while. The study of this particular leucocytozoon has also a certain importance attaching to its host. This, of course, is quite secondary to what has been stated above; but the common grey rat seems to follow man wherever he goes; and if we may deduce anything from the lessons of bacteriology and the known causal relation which the rat through the medium of its flea bears to the spread of such a deadly disease as plague, it may some day be of importance to the protozoologist to be familiar with the protozoon parasites, and more especially with the protozoon blood-parasites of the rat in this country, for comparison with those that may be found in other countries where protozoal diseases are common.

JOHN D. THOMSON.

Lister Institute,
24th November, 1908.

Appendix II.

REPORT by Dr. H. M. WOODCOCK, D.Sc., Assistant to the University Professor of Protozoology, of work done during the year ending 30th June, 1908.

My work may be considered under three headings:—

- (a) Assistance to the University Professor;
- (b) Research; and
- (c) Various.

(a) During the summer term especially, *i.e.*, from May to July, a very large portion of my time has been occupied in assisting to prepare the demonstrations following the lectures. This includes preparing specimens (slides), and arranging them to show to the best advantage, along with explanatory sketches, &c. This work has generally used up practically the whole of each lecture-day.

At other various times I have also been engaged in making preparations to augment the cabinet of protozoological slides, which has steadily grown into a most comprehensive and illustrative collection, of great educational value to any caring to study it. Particular attention has been paid to parasitic forms. The whole series is numbered and arranged and provided with a systematic card-catalogue, the formation of which alone has involved no little time and labour.

Now and again, also, I have cut sections and stained slides to assist the Professor in his research or otherwise.

In another direction, I have assisted the Professor in helping certain gentlemen who have at various times attended in the laboratory for the purpose of prosecuting protozoological research by initiating them into the complicated technique which is absolutely essential to the study of the protozoa.

(b) Except during the summer term the bulk of my time has been occupied with research.

In the autumn I began a most difficult but highly important piece of work on which I have been steadily engaged ever since. This is the study of the blood-parasites of birds, with a view to seeing how far the astounding conclusions arrived at by the celebrated German Protozoologist, Fitz Schaudinn, are true. Briefly and simply put, Schaudinn's statements are as follows:—

- (1) That certain trypanosomes in the "Little Owl" actually become intracellular in the blood-corpuscles, and indeed become, in that condition, identical with a certain malarial parasite of birds, known as *Halteridium*, from its characteristic shape.
- (2) That these trypanosomes undergo a definite and essential part of their evolution of life-cycle in mosquitoes (*Culex*), which corresponds partly to the life-cycle of the *Halteridium* in the same insects.

These views have been very widely criticised and disbelieved. Many subsequent workers have said that there is no connection whatever between trypanosomes and intracellular parasites, and that trypanosomes undergo no development whatever in insectan hosts, which act, on the contrary, solely as mechanical carriers.

Now the definite settlement of this absorbing question has a very important economic bearing, as must be at once apparent. (1) If once it can be unmistakeably established that any trypanosomes, during their life in the blood of a vertebrate, do become intracellular—or, as I may put it, enter upon a resting phase—there is no reason to doubt the possibility of some of the dangerous, that is to say, lethal, ones being able to do so too. I may perhaps point out, though this hardly comes within my own province, that in such a condition it is highly probable that the parasites would be more resistant to curative drugs, &c., and would necessitate the application of treatment different from that sufficient to dispose of the ordinary forms in the blood. (2) Again, if it can be absolutely proved that non-lethal trypanosomes of warm-blooded vertebrates do undergo some part of their life-cycle in an insectan host, and that the latter can then, after a certain lapse of time, infect anew another vertebrate, we are at once confronted with the possibility, or even probability, that the lethal parasites also are adapted to life in some insectan host. Thus another exceedingly important factor in regard to the transmission of disease-causing forms would have to be taken into account, in addition to the known one of merely mechanical conveyance. That such is actually the case is already indicated by the work of Minchin, Gray, and Tulloch in Uganda, and more than indicated—strongly suggested, in fact—by the more recent work of Stuhlmann in German East Africa. But conclusive proof is still lacking. Hence a definite knowledge of what factors are concerned in the transmission of the commonly occurring trypanosome parasites of birds—which must take place *somehow*—is just as much to be desired, and will probably furnish quite as suggestive inferences, as the discovery of the actual behaviour of the parasites in the birds themselves. These are the main objects with which I have undertaken what is proving a most laborious and exacting piece of work.

I pass on now to a brief description of the scope and methods of the investigation, as carried out to the end of last June

I intended to study first of all the parasites of the "Little Owl" itself. In spite of all my efforts, however, I could not obtain a supply of those birds here in England; so I was obliged to turn my attention to others. For my purposes, I was restricted to such birds as could be obtained alive without much difficulty and which would live healthily in captivity, since, of course, once a bird is dead, nothing more of the life-history of its parasites can be learnt, beyond what is ascertained by their examination at the time of death. I have, therefore, for the most part, used the common small cage-birds sold by dealers.

I have found trypanosomes only in members of the Finch family, viz., chaffinches (*Fringilla coelebs*) and redpolls (*Linota rufescens*). While the percentage of hosts infected is not large, still, the occurrence of trypanosomes is by no means rare. Out of 20 chaffinches examined four were found to be naturally infected; and in the

redpolls the parasites occurred in three out of 15. As far as they go these proportions are reliable, since the negative results can be relied on as well as the positive, for reasons which will appear below.

On the other hand, the parasites are usually extremely scarce in the infected birds, which renders it an exceedingly slow and wearisome process to find the trypanosomes at all in a living bird, and hampers any research upon them terribly. In this respect birds are undoubtedly the most trying of all vertebrate hosts. Some of my own experiences well illustrate this. Of the four naturally-infected chaffinches, only in one were trypanosomes observed in freshly-drawn blood; in this case I once saw a single individual in a cover-slip preparation. In the endeavour to find the parasites in stained preparations, I had to search, minutely and systematically, six good-sized films, representing a labour of several days. Only one trypanosome was found. Again, in the case of the trypanosome parasitic in the redpoll, I was not able to see it in the peripheral blood of that bird at all, during the period under review. (I have since managed to see it.) Yet on many occasions I have known that the parasites existed in the blood, though I was unable to discover them by direct microscopic examination. The only means, in most cases, of determining with certainty whether a bird is infected or not, is by taking a culture from it. I have paid considerable attention to culture-methods and have developed this branch of the technique, taking cultures from the living bird, which is a very much more difficult matter than doing so from a dead one, as has hitherto been done. It is much more difficult, of course, to ensure sterility in the former case. In a tube successfully inoculated with three or four drops of blood, I have found that in a few days (six or seven at the outside) one can generally say with confidence whether that bird was infected, according as the tube shows trypanosomes or not.

I endeavoured to produce an infection with trypanosomes in birds which I knew were uninfected. The only means at my disposal of doing this was by inoculation. In three cases out of about 25 inoculations performed, the birds were successfully infected. These were two chaffinches, one infected with a 15-day culture from a redpoll, and the other with a 7-day culture from a chaffinch; and one redpoll, infected with an 8-day culture from a chaffinch. Many of my failures resulted from the attempts to inoculate other kinds of birds with this trypanosome.

It has been a great disappointment to me that all my efforts to get mosquitoes infected with the trypanosomes, and to get the parasites transmitted to another bird by means of them, have been fruitless. I have never been able to get the mosquitoes (*Culex*) to bite birds, though I have spent a great amount of time and labour in the endeavour. I have used both reared ones (only, of course, the females), and captured "wild" ones. In the spring and early summer I bred out numbers of imagines from larvæ which I had been at pains to procure. All manner of artifices were tried to get the insects to take blood, but they refused, and would starve instead.

Whether this was due in any way to the insects being in captivity I cannot say, but at present, as the result of my failures, I am strongly inclined to doubt whether in this country *Culex* does bite birds, and act as a transmitter of their hæmatozoa to any extent. A rather significant fact is that I never saw any signs of flagellates, whether in the active or resting phase, in the stomachs of the mosquitoes, though I examined altogether a good many wild ones from different sources. It must be remembered that all the research done on *Culex* up to the present, which has shown that it can transmit certain hæmatozoa, and may at times harbour certain flagellates (which may also be hæmatozoa), has been done in countries where a much higher average summer temperature is experienced. So far as the British Isles are concerned, the question of the transmission of the naturally occurring hæmatozoa is still an unsolved problem.

With regard to the progress of the research I may mention, first of all, two or three conclusions which I have reached, bearing upon the course of an infection with trypanosomes, and the chief habitat of the parasites in the bird. After a certain incubation period, which is apparently about 9 to 12 days, the trypanosomes become fairly frequent in the blood, for avian trypanosomes that is to say. Two or three parasites can be found, for instance, in a living cover slip preparation. Soon afterwards, however, there is a distinct falling off in numbers, which goes on until what is to be regarded as the normal scantiness in number of the parasites is reached, in which condition I have found the infection may persist for at least several months.

(This refers, it should be noted, to the trypanosomes as trypanosomes; I do not intend to discuss here the question as to whether they are present in any other phase.) In general, the trypanosomes are most numerous in the bone-marrow; this is certainly their principal habitat. Even when only to be found in the blood practicably by means of cultures, two or three can usually be found in a fresh cover-slip preparation from one of the long bones of the bird; and in a carefully made smear of a small, teased-up fragment of bone-marrow, there is generally no difficulty in finding several parasites. A very interesting point is that in the night-time the trypanosomes occur in the peripheral circulation somewhat more plentifully than by day. When no trypanosomes could be seen in fresh preparations in the day-time they could be seen without much difficulty during the small hours of the morning; conversely, they are less numerous in the bone-marrow during the night. This fact points to a migration from the latter situation into the general circulation at this period.

The trypanosomes from the chaffinch and redpoll exhibit great diversity of size and appearance. Nevertheless, in spite of the considerable polymorphism shown, I consider that all the different types of form met with belong to one species, for the following reasons:—(a) Transition-forms, intermediate between the more extreme types, and serving to connect them, can usually be found. (b) The type which is to be considered as the “ordinary” indifferent form of the parasite—the medium type, that is to say, which in the existing state of our knowledge affords the chief basis of comparison in a systematic study of different trypanosomes—is similar in the chaffinch and in the redpoll.

With regard to its identification, I am inclined to think that my trypanosome is specifically distinct from others described as existing in birds up till now. The ordinary form resembles somewhat in appearance *T. paddæ*, of Thiroux, but differs in size, being longer and not so broad. Moreover, on the ground of the difference of host and distribution of this latter parasite, it is quite unlikely that my form is the same. In comparison with the much discussed *T. avium*, Danilewsky, as restricted by Laveran and Mesnil, I find that my trypanosome differs in two rather important respects from that parasite, viz., in the length of the free flagellum, which is usually much shorter, and in the appearance of the aflagellar end, which is generally more elongated and attenuated. Again, the trypanosome to which Laveran and Mesnil restrict Danilewsky’s specific name occurred in an owl, and is probably the same as one of the forms originally observed by Danilewsky and confused by him under one name together with the others, which are probably distinct. Using the term *T. avium* in the sense of Laveran and Mesnil, which I consider to be correct, at any rate for the present, the trypanosome of the chaffinch and redpoll is most probably a different form from the trypanosome of these authors. To sum up, I am disposed to regard it provisionally as a new species.

Turning now to a consideration of the trypanosomes as they occur in cultures, one of the most striking differences from their behaviour in the blood is with respect to their multiplicative capacity. In the bird, multiplication, or division, seems to be almost entirely in abeyance. At all events, I have never seen a properly dividing form, whether in the peripheral blood or in the bone-marrow. This is a remarkable feature, and, of course, is one factor explaining the numerical infrequency of the parasites. On the other hand, so soon as the trypanosomes are transferred to the culture-tube, and are consequently at a temperature considerably below blood-heat, multiplication goes on actively. I have some really excellent preparations of cultural forms in every phase of division, showing cytological details quite clearly.

The form and appearance of the parasites in cultures is entirely different from what it is in the blood of the bird. Among the cultural forms, too, there is great variation. And in this connection it must be particularly noted that I am referring only to perfectly normal or healthy types; types which have their counterparts, I feel confident, in the development or part of the life-cycle undergone naturally in some alternate (probably insectan) host. There is in general no difficulty in distinguishing between such forms and what are manifestly abnormal, unhealthy phases, which often resemble the weird, irregular appearances described by some of the earlier workers.

The predominating type, which corresponds, as it were, to the “ordinary” type in the blood, is well defined. I intend to call it the *trypanomonad*-form of the parasite. It is elongated and slender in shape, the width usually varying only slightly

for the greater part of the length of the body. The distinguishing characters are as follows:—The two nuclei are *always* close together near the middle of the body; and the attached part of the flagellum has at least a narrow undulating membrane, which may be fairly prominent. The kinetonucleus is never near either end of the body. It is important to note that this form differs essentially from a true herpetomonad-type.

In conclusion, I will add that I consider my cultural work has been of much value, not only in aiding me to determine the existence of trypanosomes in the birds examined, but also from the very marked indications it has afforded me of the development of certain definite types of the parasites, in extra-corporeal conditions, of the significance of which I have, as already mentioned, little doubt.

(c) *Various*.—Under this heading I may include the identification of specimens sent me to report upon and explain. Thus, I have several times been asked by Mr. Johnston, of the Sea-Fisheries Laboratory, Liverpool, to report on diseased fish, of which he has sent me specimens. These are generally infected with myxosporidia of different kinds, which may cause serious injury. On another occasion I received from a gentleman in the Indian Medical Service portions of the diseased kidney of a turtle, which he thought was infected with a parasitic protozoan. Here, too, I found a myxosporidian to be concerned, which I identified and described to him. Similarly, on two or three other occasions, I have been able to be of help in this connection. This direction, indeed, is one in which the Protozoological Department will probably come to be of considerable service to other researchers, especially as it becomes more widely known.

H. MELLOR WOODCOCK.

The Lister Institute,
November 24th, 1908.

Appendix III.

LIST OF WORKS published from the Laboratory of Protozoology, 1907-08.

By Professor E. A. MINCHIN, M.A., V.P.Z.S.:—

- (1) The Hæmoflagellates; a discussion (opening address), "British Medical Journal," November 9th, 1907, pp. 1,320-1,322.
- (2) Investigations on the Development of Trypanosomes in Tsetse Flies and other Diptera, "Quarterly Journal of Microscopical Science," 52, March, 1908, pp. 159-260, plates 8-13, 2 text figures.
- (3) On a Hæmogregarine from the blood of a Himalayan Lizard (*Agama tuberculata*), "Proceedings of the Zoological Society," 1907 (May, 1908), pp. 1,098-1,104, plates LV.-LVI.

By J. D. THOMSON, M.A., M.B., C.M.:—

- (4) Cultivation of the Trypanosome found in the blood of the Goldfish, "Journal of Hygiene," VIII., pp. 75-82, plate III.
- (5) (With Plimmer, H.G.) A preliminary Summary of the results of the Experimental Treatment of Trypanosomiasis in Rats, "Proceedings of the Royal Society," B. 79, pp. 505-516.
- (6) (With Plimmer, H.G.) Further results of the Experimental Treatment of Trypanosomiasis in Rats, *Ibid.*, B. 80, 1908, pp. 1-12, plate I.

By H. M. WOODCOCK, D.Sc.:—

- (7) Protozoa, "Zoological Record," XLIII., 48 pp.
 - (8) Hæmoflagellates and Allied forms, in Lankester's "A Treatise on Zoology," Part I., Fasc. I., pp. 193-273, 40 text figures. (In the press; shortly to appear.)
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APPENDIX IV.

MR. F. P. JEPSON to COLONIAL OFFICE.

(Received 5 November, 1908.)

Quick Laboratory, New Museums, Cambridge,
3 November, 1908.

SIR,

I SUCCEEDED Mr. A. H. Lees as student in medical entomology in this University at the close of the winter term of 1907, and commenced work at the beginning of January, 1908.

In accordance with the request that the student in medical entomology should furnish a report upon his work from time to time to the Advisory Committee for the Tropical Diseases Research Fund, I herewith beg to inform you of the manner in which my time has been spent.

The months succeeding January were spent in continuing Mr. Lees's work with the bed-bug (*Cimex lectularius*).

The work consisted in the completion of various rearing experiments at different temperatures, in experiments to show the longevity of the adult and young without food, and in various dissections to show the internal anatomy of this insect. These latter occupied much time, as a considerable amount of practice was required before any good results were obtained.

Much time was also spent in vain attempts to secure good sections of the adult, but owing to the peculiarly resistant chitin of this insect little success attended my efforts.

I hope, however, in the near future to obtain more satisfactory results, as I have received many valuable suggestions to overcome the difficulty.

I have also commenced a detailed description of the insect, which I hope to complete in due course.

Collections have been arriving from time to time from various parts of the world, as the outcome of Professor Nuttall's circulars despatched to the Colonies, and these have had to be identified, either by myself, or, in the event of my inability to do so, by various experts to whom they have been sent, viz.:—The Hon. N. C. Rothschild, Mr. F. V. Theobald, Miss Ricardo, Dr. Sharp, and Professor Nuttall.

Upon identification, a complete set of specimens (where possible) has been returned to the collector with a report, a duplicate report being retained for reference.

Some 250 specimens have been received, of which about 180 have been identified and reported on, and the rest are at present in the hands of various experts from whom I shortly expect them to be returned, when they will be reported on to their various collectors.

Specimens have been received from Southern Nigeria (Lagos and Ebute Metta), West Indies, New South Wales, Gambia, Mauritius, British Guiana, Nyasaland, Straits Settlements, Western Australia, Uganda, Rhodesia, Sudan, Borneo, Simla, Cape Colony, and Transvaal.

A collection is being formed from the specimens received, and to this I have had to attend. Also a careful record is kept of each specimen in a book provided for the purpose, and this contains all details as to number, name, collector, identifier, and date of each specimen.

I beg to enclose one or two of my duplicate reports,* as types of those sent abroad to collectors.

I am, &c.,
FRANK P. JEPSON.

* Not printed.

APPENDIX V.

No. 1 in Appendix V.

THE LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 14 May, 1908.)

Seamen's Hospital Society,

SIR,

Dreadnought Hospital, Greenwich, S.E., 13 May, 1908.

I HAVE the honour to enclose herewith, for the information of the Tropical Diseases Research Fund Committee, the half-yearly reports from the following special departments of the London School of Tropical Medicine:—

Arthropodology.—Colonel A. Alcock, I.M.S., C.I.E., F.R.S.,

Helminthology.—R. T. Leiper, M.B., Ch.B., F.Z.S.,

Protozoology.—C. M. Wenyon, B.Sc., M.B., B.S.,

together with the manuscript of a paper* on *Physaloptera mordens*, a new intestinal parasite of man, read before the Society of Tropical Medicine and Hygiene, December, 1907, by R. T. Leiper.

I am, &c.,

P. MICHELLI,

Secretary.

Enclosure 1 in No. 1 in Appendix V.

LONDON SCHOOL OF TROPICAL MEDICINE.

REPORT of Arthropodologist for Six Months ending 30 April, 1908.

Arthropodological Department, Royal Albert Dock, E., 1 May, 1908.

1. I took over charge on the 1st October, 1907. Prior to that date I had given some time to selecting accommodation, planning the necessary fittings, and arranging for equipment.

2. Reviewing the work of the Arthropodological Department as a whole, I may mention that it has been devoted almost entirely to work of a preliminary nature, such as sorting collections and preparing the ground for teaching.

3. *Acquisitions*.—Material, consisting of mosquitos and other blood-sucking flies, bugs, lice, fleas, ticks, and specimens of various other noxious animals, including venomous snakes, has been received from Africa (Central, East, West, and South), British Guiana, Great Britain, Hong Kong, India, and the Malay States. The following is a list of the donors, grouped geographically:—

- (a) Africa, Central (and Uganda): Dr. A. G. Bagshawe, Dr. H. Bayon, Dr. R. T. Leiper, Dr. Yale Massey.
- (b) Africa, East (and Mauritius): Dr. A. J. Milne, Dr. W. Woolliscroft.
- (c) Africa, West: Dr. H. E. Arbuckle, Dr. R. E. Horn, Dr. H. P. Lobb.
- (d) Africa, South: Dr. L. Bostock.
- (e) British Guiana: Dr. von Winckler, Dr. K. S. Wise.
- (f) Great Britain: The British Museum, Dr. C. W. Daniels, Professor R. T. Hewlett, Professor G. F. H. Nuttall, the Hon. N. Charles Rothschild, and myself.
- (g) Hong Kong: Dr. A. H. Heanley.
- (h) India: Lieutenant-Colonel J. R. Adie, Major A. T. Gage, Lieutenant-Colonel C. R. M. Green, Captain G. A. Harriss, the Indian Museum, Mr. B. B. Osmaston, Lieutenant-Colonel D. C. Phillott.
- (i) Malay States and Islands: Dr. J. D. Gimlette, Mr. H. Pratt, the Raffles Museum, Dr. A. T. Stanton, Dr. M. Watson, Dr. A. R. Wellington.

The amount of material received is encouraging, and special mention may be made of the following items:—Indian mosquitos from Lieutenant-Colonel Adie.

* Not printed.

Authentically determined duplicates of flies from the British Museum. A large collection of Romney Marsh mosquitos from Professor R. T. Hewlett. A fine collection of Indian venomous snakes from the Indian Museum. East African blood-sucking flies from Dr. H. P. Lobb. Malayan blood-sucking flies from Mr. H. Pratt—a very fine series. Malayan venomous snakes from the Raffles Museum. Authentically determined fleas from the Hon. Charles Rothschild—a valuable series. Malayan flies from Dr. A. T. Stanton. South American mosquitos and predaceous flies from Dr. K. S. Wise.

4. *Collections*.—The collections are being arranged in two series—a reference collection of choice specimens arranged geographically, and a teaching collection for class work.

(A) *Reference Collection*.—A beginning has been made.

(B) *Teaching Collection*.—Good progress has been made with this: all the specimens have been sorted and systematically arranged: most of the material has been generically and much of it specifically determined. A large number of permanent preparations conducive to the recognition of arthropoda of practical importance in tropical medicine has been made.

5. *Teaching*.—A great deal of preliminary work necessary for the development of the practical teaching of the subject has been done, as I think that success in this direction, besides being the justification of the Department, will bring a good return in the shape of collections from students who pass through the School. During the Autumn Session I gave two lectures of an introductory nature on arthropoda, and two on snakes and snake-venoms. During the Winter Session I delivered a course of six systematic lectures on arthropoda, and gave fourteen demonstrations of arthropods of practical importance in tropical medicine: I also gave two lectures on snakes and snake-venoms, and a demonstration of methods of collecting, preserving, and packing specimens. More than thirty sheets of diagrams and enlarged drawings have been made by me for the purpose of these lectures.

One student sent by the Ceylon Government received a special course of instruction in methods of work.

A. ALCOCK,
Lieutenant-Colonel, I.M.S. (retired).

Enclosure 2 in No. 1 in Appendix V.

LONDON SCHOOL OF TROPICAL MEDICINE.

REPORT of Helminthologist for Six Months ending 30 April, 1908.

Helminthological Department,

SIR, Royal Albert Dock, E., 1 May, 1908.

I HAVE the honour to submit my half-yearly report as Helminthologist to the London School of Tropical Medicine. Under a recent re-arrangement of the School curriculum the lectures and laboratory instruction in human helminthology have been allocated to me. The following outline of the course given by me during the session lately concluded indicates its extent and the point of view from which the subject is treated.

Synopsis of Lecture Course.

Definition of helminthology. Its relationship with zoology and pathology. Position of the helminthes in the zoological system. The various forms of parasitism found. The pathological effects of the helminthes on their hosts. The distribution of the helminthes in the human body.

Guiding principles in helminthological nomenclature and classification. The main divisions of the helminthes: Nematelminthes and Platyhelminthes, their distinguishing features in structure and life-history.

The general topography of the Nematode body.

The Nematelmintha and its sub-divisions.

The main characteristics of the families into which the human Nematoda are grouped: Anguillulidæ, Angiostomidæ, Oxyuridæ, Ascaridæ, Physalopteridæ, Gnathostomidæ, Filaridæ, Strongylidæ, Trichotrachelidæ.

Definition of the genera and descriptions of the various Nematode species met with in tropical practice. The larval development of the Nematoda.

The Platyhelmintha and its sub-divisions.

Structural contrasts between the Turbellaria, Trematoda, and Cestoda.

The general topography of the Trematode body.

The structures that are of importance in classification and the manner in which they are found to vary.

The distinguishing features of the three Trematode families—Fasciolidæ, Paramphistomidæ, and Schistosomidæ.

Definition of the sub-families Fasciolinæ, Opisthorchinæ, Heterophyinæ, Dicrocoelinæ, Paramphistominæ, and Cladorchinæ.

Description of the various genera and species of Trematoda that affect man in the tropics. General account of Trematode development.

The Cestoda: distinctive features in their anatomy and life-history.

The structure of the Cestode body: strobila, scolex, segment.

The variations in the design of scolex and reproductive organs that are of importance for purposes of classification. Other variations that are to be regarded as monstrosities.

Division of the Cestodes into Pseudophyllidæ and Cyclophyllidæ.

Definition of the families: Dibothriocephalidæ, Dilepinidæ, Davainiidæ, Hymenolepinidæ, and Tæniidæ.

Description of the genera Dibothriocephalus, Diplogonoporus, Sparganum, Dipylidium, Davainea, Hymenolepis and Tænia. The differentiation of the various species of each genus known in man.

An account of the development of the Cestoda with special reference to the formation of Hydatids in man. The points of similarity and contrast between the Cysticercus and the Echinococcus. "Sterile" cysts.

The manner in which man becomes infected.

Each lecture was supplemented by a demonstration of the various parasites treated of in the lecture and the student thus became familiarised with the naked eye appearances of the more important forms met with in the tropics. Concurrently with the systematic course, a course of practical instruction extending over three weeks was given in the laboratory. The methods of collecting and preserving material were demonstrated and the examination and recognition of the important structures of many of the human parasites practised. Each member of the class mounted and retained for future reference a considerable number of helminthological "types." Moreover, the series of human helminthes in the Bomanji-Petit Museum, which is probably the most comprehensive in England, was always accessible for further study and reference.

Examination of Material from Abroad.

During the past six months I have been in correspondence with, and have supplied information to, workers in my subject both in England and abroad. The amount of material arriving for report still continues to increase. Specimens from the Gold Coast, Nigeria, Natal, Cape Colony, Transvaal, British East Africa, India, Federated Malay States, Western Australia, China and the West Indies having been submitted to me for examination.

This correspondence and material ranged over a very wide field, for I was consulted not only on matters pertaining strictly to human infections, but also upon parasites that cause disease in animals of economic importance and I have supplied information concerning the structure and life-history of such parasites and offered suggestions for their eradication.

The number of helminthes that infest domesticated animals is very great and the important rôle they play in the production of many diseased conditions in these animals is now universally recognised. The literature of veterinary helminthology is very much scattered and almost wholly inaccessible to ordinary investigators in this branch of parasitology in the tropics. It seems a direction in which the scope of the work of my Department may be usefully extended in the future to supply information on these matters to workers isolated from recent helminthological literature. I propose also, with the sanction of the Committee, to add to the helminthological collection in the School Museum a "Veterinary Section" illustrating the parasitic worms that are of economic import. For this purpose a very

considerable number of such species is already available from collections made by me during the past three years.

Original Investigations.

In my report for the half-year ending October, 1907, I mentioned that I had brought back from my recent visit to Uganda a number of human parasites obtained post-mortem from natives of that country, and I stated that one of these parasites belonged to a genus that had only been once reported from man. Microscopical investigation revealed the presence in this form of certain characters that has since enabled me to differentiate it from the one previously known and, accordingly, I have (at a demonstration to the Society of Tropical Medicine and Hygiene, December, 1907), named the new species *Physaloptera mordens*. (I append the manuscript of an account, at present passing through the Press, of the anatomy of this new human parasite.) Its occurrence in Central Africa probably is much more frequent than is at present apparent for, on account of its close resemblance in shape and size to somewhat immature ascarides, it possibly has hitherto been overlooked. Indeed, in one of two further cases, from Nyasaland natives, that have since come under my notice, the specimens were forwarded as ascarides.

Another interesting find I am able to report, through the kindness of Dr. Turner, of Johannesburg, who sent the material for examination, is the occurrence of *Triodontophorus deminutus* Railliet, a parasite of man that has hitherto been noted but once.

At the suggestion of Sir Patrick Manson I have devoted some time to the study of the anatomy of the bilharzia worm with a view to throwing further light upon the problem of the significance of the lateral spined ova that are found to occur in certain cases.

The question is one that has recently been brought into prominence and has been warmly debated in scientific circles. Sambon, adopting Manson's view in opposition to that held by Looss, created a new species for the undetermined form that gives origin to the lateral spined egg, basing his specific characterisation on the shape of the egg and the different geographical distribution of this form from that with a terminal-spined ovum.

The material at my disposal has been limited and the number of female *Schistosoma* exceedingly so. The specific differences recorded for the various *Schistosoma* of Herbivores shows that the points of importance lie in the relations of the parts of the female system to one another and to the divisions of the alimentary canal. I have, however, been forced to depend entirely upon male specimens in my investigations. This point is insisted on here as the limited number of my observations may enable the results obtained to be discredited by further examinations.

From my material (received from the Transvaal) I have been able to satisfy myself of the following facts.

- (a) Both terminal and lateral-spined bilharzia eggs occur together and separately in natives working in the mines in the Transvaal.
- (b) The lateral-spined ova occur only in the rectal tissue and occur there in very great numbers, thus precluding, to my mind, the idea that the ovum with a lateral spine is, as has been suggested, the product of a too early impregnated female.
- (c) The lateral spine is exceedingly uniform in shape and character and seems to be of a distinct type from the somewhat displaced terminal spines occasionally seen in cases in which the terminal-spined ova abound.
- (d) The actual shape of the eggs is different.
- (e) While it is true that the females containing lateral-spined eggs contain only one ovum at a time as a rule (so far as I have seen), the ootype is much larger than the contained egg, and, in the specimens I have seen, seems singularly free from granular debris. Now it is an essential point in Looss's explanation of the orientating of the egg as it passes into the ootype that it cannot do so easily, but meets with resistance from the amount of abortive ova and yolk cells that block the cavity of the ootype, and that this causes it to be shelled asymmetrically.

- (f) In the males of bilharzia specimens collected from the portal vein in cases of mixed infections as ascertained by microscopical examination of bladder and rectal walls I have been able to separate into two groups males having four somewhat angular large testes from others having seven to nine small spherical testes. In other cases all the males obtained belong to one type. The difference in character and especially in number of testes would be considered by helminthological authorities, if occurring in other groups, and if constant as it seems to be here, as a specific character of some reliability.
- (g) In order that this character can be utilised in support of the view that the two forms of bilharziasis, rectal and urinary, are caused by parasites specifically distinct, it remains to be shown that males having one particular type of testes are usually or always in sexual conjunction with females producing one type of egg.
- (h) The probabilities are, granting for the moment that these types of testes and of egg be found constantly to occur, that the male with four testes is the mate of female giving rise to the terminal-spined egg. For this is the normal arrangement of testes that has up to the present been figured and noted and is that given by Looss, while the terminal-spined ovum is the one recognised by him as being the normal product of the mate of this form.
- (i) In support of this view I am able at present to offer only one actual observation, in itself a striking one, owing to lack of females in copulation with the males in my material. In the one specimen of a pair in this position the number of the testes can easily be made out to be seven, at any rate, in the male. The female lies in the gynæcophoric canal, but its posterior half has broken off. Lying also in the canal, however, is a small clot containing several lateral-spined ova. We have then evidence of the association of the multi-testicular male with the female having lateral-spined eggs.

These observations by no means finally settle the question at issue or completely dispose of the theories based on an assumption that the atypical egg is a pathological product, but they certainly render a reconsideration of the detailed anatomy of the *Schistosomum hæmotobium* highly desirable.

In connection with the practical course on human helminthology conducted by me at the Tropical School last session, I personally revised the anatomy of several of the human helminthes and observed several details in structure that are worthy of annotation.

Filaria perstans.—In the adult male the number of papillæ recorded is four præ-anal and one post-anal pairs. I, however, find that there are in fact two distinct pairs of post-anal papillæ in *F. perstans* from Africa and America. The original types also bear out the same observation. This is a matter of importance, as the number of the post-anal papillæ in the genus *Filaria* is a character that may determine the species.

Filaria bancrofti.—The form and arrangement of the copulatory apparatus in this species has not been thoroughly investigated. The spicules differ remarkably in shape from one another and from those of other *Filaria*. The form of the large spicule only is correctly described. The lesser spicule is short and stoutly built, it is not prolonged into a tapering distal portion as is the larger spicule, but ends bluntly, what has been mistaken for a tapering portion bent back along the haft probably being the sharp ridge that does run along the border of this lesser spicule.

In addition to the two spicules there is in *F. bancrofti* a distinct cup-shaped "accessory piece" perforated by innumerable pittings.

There are no papillæ on the tail of the male, *i.e.*, there are no fleshy paired projections containing nerve fibrils. The skin does not show transverse striations.

The *Filaria bancrofti* in its structure, particularly in the design of the spicules, and in its peculiar habitat is a very atypical member of the genus to which it belongs.

Cladorchis watsoni.—The systematic position of this parasite has not yet been finally agreed upon. The species originally described as an *Amphistomum* is variously placed by authors in the genus *Paramphistomum* or *Cladorchis*.

The parasite has, however, a pair of pharyngeal pouches, and it cannot, on that ground alone, be included in any genus of the sub-family *Paramphistominæ*.

The presence of these pouches on the other hand admits it to the sub-family *Cladorchinæ*, but it may not be properly placed in the genus *Cladorchis*, in my opinion, because the edges of the body are sharply defined and are produced forwards to the anterior end of the body as two stout processes. Further, there are, too, peculiarities in the arrangement of the musculature of the œsophagus and the presence of a greatly developed genital papilla. The descriptions given of this parasite place the testes side by side, but I am satisfied from an examination of one of the original type specimens in serial sections that they in reality lie one behind the other—an additional character in which the species departs from the typical *Cladorchis*.

While reading Cobbold's account of the appearance of his *Amphistomum ornatum*, I was recently struck by its apparent similarity to *Cladorchis watsoni*, and I obtained permission to examine one of the original types of that species. The systematic position of *A. ornatum* was until then undeterminable owing to the fact that there was no account in literature of its internal anatomy, which had indeed not been investigated. I was able to place the species in the sub-family *Cladorchinæ* and to ascertain that in the more intimate details of its structure it does in fact closely resemble *Cladorchis watsoni*, from which it can be quite clearly differentiated. I am in no doubt that these two forms, *C. watsoni* from man and *A. ornatum* from the elephant, together constitute a natural genus of their own, more nearly related to *Chiorchis* than to *Cladorchis*.

The collection of parasites of the domesticated animals and wild game of Uganda made by me last summer has occupied the remainder of the time not devoted to teaching and to work upon parasites bearing upon human disease and its causation. The progress made has been slow owing to the large mass of foreign literature involved. A considerable number of new forms have been determined and I am now completing descriptions of these for publication. My notes at present include two new genera and several new species of twelve different genera that have been already defined.

Perhaps the most important observation of practical value to Uganda that I made concerning the parasites of the domesticated animals there is their extraordinary freedom from helminthic infection as contrasted with the conditions obtaining in Egypt and to a less extent in British East Africa.

There was an entire absence of lung strongyles and of liver flukes in the sheep, goats, and cattle I saw slaughtered at the abattoir in Entebbe or that were killed by us during the whole tour. These two kinds of parasites alone involve other countries in enormous losses, and as Uganda becomes more generally developed, it may be a matter to be well worthy of consideration by what means the native stock can be best protected from these disastrous parasites.

I have, &c.,
ROBERT T. LEIPER.

Enclosure 3 in No. 1 in Appendix V.

LONDON SCHOOL OF TROPICAL MEDICINE.

REPORT of Protozoologist for Six Months ending 30 April, 1908.

Protozoological Department, Royal Albert Dock, E., 1 May, 1908.

The period covered by this report forms the second half of the year, during which I have pursued investigations in the Anglo-Egyptian Sudan in connection with the Wellcome Research Laboratories of the Gordon College, Khartoum. As stated in my last report for the six months preceding October 31st, 1907, my work has been on the Nile and its tributaries, and to this end I have travelled in the floating laboratory recently constructed for the Gordon College from funds supplied by the Sudan Government and by Mr. Wellcome, through whose generosity also the expenses of this expedition have been partly met.

My last report was made from Wau in the Bahr el Ghazal Province, at which station I remained till the second week in October, when I was compelled to leave on account of an unexpected fall in the Jur River. With difficulty was the floating laboratory brought down to the Nile. At the Barboy Wood station on the Nile I remained one month and then travelled south to Bor which was left at the beginning of February, in order to visit the Sobat River, where an epidemic was killing off

large numbers of cattle. I returned to Khartoum at the end of February and reached England on March 22nd having been absent a year and three weeks.

I will take this opportunity to say that at the Government stations I visited and wherever I came in contact with them I met with every courtesy at the hands of the Government officials, many of whom put themselves to considerable trouble to assist me in my work. I must not omit to mention the assistance I received from the staff of the American Mission on the Sobat River, who did much to dispel the suspicions of the Shilook tribe and thereby rendered easy the examination of their cattle, and the study of the epidemic previously mentioned.

As was the case when I wrote my last half-yearly report it is impossible at present to describe very precisely much of the material I have brought home; this awaits a more careful examination.

I will now describe, as I have done in previous reports, under their respective heads, the more salient points in some of the observations I have made.

Hæmamoeba in Lizards.—I reported from Wau that I had found in certain reptiles *Hæmamoeba* resembling one known to occur in the blood of Indian turtles. Much doubt has existed as to the true nature of these parasites. Some observers have held that they were related to the *Hæmamoeba* of warm-blooded animals, while others considered them connected with the *Hæmogregarines* which occurred in the blood at the same time. I was able to clear up this point satisfactorily, for after the addition of acid citrate solution to the blood I observed the formation of microgametes in a manner exactly similar to that which occurs in the case of the malarial parasites of birds. The asexual multiplication stages I found in the blood while the microgamete formation seems to indicate a secondary host, possibly the ticks which infested the infected animals.

Hæmamoeba of Guinea Fowl.—This parasite was discovered by Neave in guinea fowl in the Sudan. Its importance depends on its relationship with another similar, if not identical, parasite of the owl which formed the subject of Schaudinn's now famous research from which he considered he had observed a connection between the *Hæmamoeba* and Flagellates which was to revolutionise our views of the Protozoa. Schaudinn's views have been called into question by several observers, but they have lately received some support from a publication describing a similar *Hæmamoeba* of the silver hawk of the Congo by Dutton, Todd, and Tobey, these observers agreeing with Schaudinn in his views that the larger forms of parasite have engulfed the host cell and that the prolonged extremities of the spindle body in question represent parts of the parasite. From observations on the fresh blood controlled by examination of stained blood films I have been driven to the conclusion that the above views are quite fallacious if applied to the parasite of the guinea fowl, and, as the parasite of this bird resembles that of the owl to such a marked extent, it cannot be supposed that it would act in any very different way, and I feel sure that if observations were made upon the parasite of the owl in the fresh and stained blood under conditions similar to those I employed, the results must be the same, and it would be found that the parasite described by Schaudinn was not merely the parasite but the parasite plus infected cell. In other words Schaudinn was mistaken in regarding the infected cell as part of the parasite, and the same is true of the views of the workers mentioned above who have followed Schaudinn in his views. If this be true that Schaudinn was mistaken in a question so fundamental as the structure of the parasite with which he worked resulting in a confusion of parasite with infected cell, grave doubt is thrown on the detailed relation described as existing between the *Hæmamoeba* and trypanosomes.

Chicken Spirillosis.—This disease was found by Dr. Balfour to occur in chickens in Khartoum. Further south I found it in fowls from Meshra el Rek in the Bahr el Ghazal Province and at Bor on the Jebel River. I saw one guinea fowl die of this disease, and at Bor fowls brought by natives for sale on the river easily contracted the malady. It would thus appear that at Bor the disease is confined to the river, perhaps being a recent introduction. The disease and the spirochætes causing it resembled in every way the condition described as occurring in fowls from other parts.

Cattle Disease.—A large proportion of the cattle on the Sobat River were suffering from a slow wasting disease which generally brought about the death of the animal. At the Sobat Mission Station between 20 and 30 per cent. of the cattle had died, and, as far as could be ascertained, about the same proportion had died amongst the native herds round about. An examination of the blood showed that

the sick cattle in nearly every case harboured a small trypanosome named *Trypanosoma nanum*. This trypanosome bears a very marked similarity to the small forms of *Trypanosoma dimorphon*, and it has been suggested by some that the two are identical, but from inoculation experiments this seems improbable. The examination of the Sobat cattle not only revealed *Trypanosoma nanum*, but also two other parasites of the Piroplasma or Babesia group, viz., *Babesia bigeminum* and *Babesia mutans*, both of which are found in blood of cattle in South Africa. Only in one cow on the Sobat River was the former of these two parasites found, while the latter was present in nearly all the cattle harbouring *Trypanosoma nanum*. Cattle infected with this trypanosome in Wau in the Bahr el Ghazal Province also showed *Babesia mutans*. The occurrence of *Babesia bigeminum* and *Babesia mutans* has not previously been noted from the Sudan. At first I was of the impression that *Babesia mutans* was *Babesia parvum*, but Captain Olver, the Principal Veterinary Officer to the Sudan, kindly examined my slides and expressed the opinion that the infection was one of *Babesia mutans* which he had seen in South Africa.

The triple infection of the Sobat cattle with *Trypanosoma nanum* and the two forms of Babesia, each one of which might cause disease, made the actual cause of the epidemic under consideration somewhat obscure. However, as *Trypanosoma nanum* was found in the blood of all the cattle with the disease well advanced, while *Babesia mutans* was found in some healthy animals, the former was probably the cause of the epidemic, though each parasite might help the other, so to speak, and infection with either one rendering more easy a subsequent infection with the other. *Babesia bigeminum* was only found in one cow, so cannot be held responsible.

Attempts were made to determine the mode of transmission of this trypanosome. The cattle were liable to bites from ticks and various species of fly of the Tabanus, Stomoxys, and Hippobosca groups. Glossina does not occur here. Owing to the difficulty of obtaining any animal into which *Trypanosoma nanum* could be easily inoculated these experiments were without definite result. It may be mentioned that in the intestine of one Hippobosca taken off a sick heifer *Trypanosoma nanum* was found.

Inoculation experiments produce evidence against the view mentioned above viz., that *Trypanosoma nanum* is merely the small form of *Trypanosoma dimorphon*. The latter trypanosome as it occurs in the Sudan is very easily inoculable into rats and the infected rats show both large and small forms. Blood containing *Trypanosoma nanum* rarely (one case out of twelve) gives rise to infection in rats. Had the two trypanosomes been identical, it would have been expected that the *Trypanosoma nanum* would easily give rise to infection. Other reasons could be cited for adopting the view that these two trypanosomes belong to distinct species.

Trypanosoma nanum is thus a species of trypanosome distinct from *Trypanosoma dimorphon*. I have found it in cattle in the Bahr el Ghazal Province, on the River Sobat, and also in one cow from Uganda. This form of trypanosomiasis is not only widely spread over Southern Sudan, but extends into Uganda.

The small trypanosome which causes disease in mules and donkeys in the Bahr el Ghazal Province morphologically resembles *Trypanosoma nanum* and experimentally I have found it impossible to inoculate from donkeys to rats. *Trypanosoma nanum* and the small trypanosome of donkeys and mules are probably identical.

In connection with trypanosomiasis at Wau in the Bahr el Ghazal Province I experimented with *Glossina palpalis* and *Trypanosoma dimorphon*. At Wau itself only *Glossina palpalis* is found, while a few miles out of the town *Glossina morsitans* occurs. With *Glossina palpalis* I was unable to transmit *Trypanosoma dimorphon* from rat to rat, and this agrees with the practical experience that animals kept in Wau do not contract disease, but if they are allowed to go a few miles out of the town they may sicken and die from disease caused by *Trypanosoma dimorphon*. The importance of this is that an animal will remain healthy in Wau and that a sick animal is not likely to start an epidemic amongst animals in Wau, which would certainly be the case if *Glossina palpalis* could transmit the infection.

In conclusion I may say that many other observations have been made in parasitic Protozoa and that I have added to my collection of parasitic worms and biting flies. This material I shall investigate and report upon in the near future.

C. M. WENYON.

No. 2 in Appendix V.

THE LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 16 November, 1908.)

London School of Tropical Medicine (University of London),

SIR,

Royal Albert Dock, E., 13 November, 1908.

I HAVE the honour to send you, for the information of the Tropical Diseases Research Fund Committee, the half-yearly reports of:—

The Arthropodologist.—Colonel A. Alcock, I.M.S., C.I.E., F.R.S.;

The Helminthologist.—R. T. Leiper, Esq., M.B., Ch.B., F.Z.S.;

The Protozoologist.—C. M. Wenyon, Esq., B.Sc., M.B., B.S.;

together with the following publications*:—

"The occurrence of a rare Sclerostome of Man in Nyasaland," by Dr. R. T. Leiper.

"*Physaloptera Mordens*: a new intestinal parasite of Man," by Dr. R. T. Leiper.

"Note on the Anatomy of *Cystidicola Farionis*," by Dr. R. T. Leiper.

"Some Generic Names that have been omitted from recent Zoological Indices," by Dr. R. T. Leiper.

"Generic Names of Polychæt Worms that have been preoccupied and remain unreplaced," by Dr. R. T. Leiper.

"An account of some Helminthes contained in Dr. C. M. Wenyon's Collection from the Sudan," by Dr. R. T. Leiper.

"Report of Travelling Pathologist and Protozoologist in the Floating Laboratory of the Wellcome Research Laboratories, Gordon College, Khar-toum," by Dr. C. M. Wenyon.

In regard to the other work of the School the Tropical Diseases Research Fund Committee may desire to be informed that during the year 96 students have entered their names as against 90 in the previous corresponding period. These may be classified as follows:—

Colonial Service	...	...	...	...	...	...	30
Indian Medical Service	...	...	...	...	...	...	12
Royal Army Medical Corps	...	...	...	...	...	...	2
Missionary Societies	...	...	...	...	...	...	7
Private Students	...	...	...	...	...	...	41
Other Governments	...	...	...	...	...	...	4
							—
							96
							—

The students entered for the following periods:—

For the full course of three months	...	...	...	...	...	62
For two months and over	...	...	...	...	...	13
For one month and over	...	...	...	...	...	21
						—
						96
						—

Fourteen students obtained the Cambridge diploma in tropical medicine and hygiene.

Considerable additions have been made to the museum during the year by past students and others.

I am, &c.,

P. MICHELLI,

Secretary.

Enclosure 1 in No. 2 in Appendix V.

REPORT OF THE ARTHROPODOLOGIST, 1ST MAY TO 31ST OCTOBER, 1908.

London School of Tropical Medicine,

Royal Albert Dock, E., 1 November, 1908.

I have the honour to submit my report on the work of the Arthropodological

Department for the half-year ending 31st October, 1908, with the preliminary explanation that it includes not only arthropodology but also sundry branches of "medical zoology" not otherwise provided for in the School.

2. Considerable progress has been made in the two fundamental essentials of forming (*a*) authentically-named reference-collections of arthropods and certain other forms of pathological import, and (*b*) a collection of generic and specific types for purposes of demonstration and study in the class-room.

3. *Acquisitions*.—Material, consisting of blood-sucking flies, fleas, lice, ticks, and other parasitic acarines, leeches, and venomous snakes, has been received from the following localities and correspondents:—

- (A) *Britain*.—Fleet-Surgeon P. W. Bassett Smith, Dr. Newham, Professor R. T. Hewlett.
- (B) *Africa, Central and Uganda*.—Dr. H. Bayon (five consignments), Dr. R. Howard, Dr. Sells, Dr. Wenyon.
- (C) *Africa, East*.—Dr. W. Woolliscroft.
- (D) *Africa, West*.—Dr. H. E. Arbuckle, Mr. G. C. Dudgeon, Dr. W. M. Graham, Dr. J. M. O'Brien, Dr. W. P. Roach.
- (E) *America, South*.—Mr. Claude Horton, Dr. F. Law, Dr. K. S. Wise.
- (F) *America: West Indies*.—Dr. C. W. Branch, Dr. Burrows, Dr. A. A. Myers.
- (G) *Asia*.—Dr. N. Annandale (India), Dr. Atkinson (Hong Kong), Dr. A. G. Barker (Borneo), Dr. J. D. Gimlette (Siam), Captain W. S. Patton, I.M.S. (India), Dr. Arthur Powell (India), Mr. H. C. Pratt (Malay States), Dr. A. T. Stanton (Malay States), Dr. A. Tingle (North China), Dr. A. R. Wellington (Borneo).

I understand that the thanks of the School have been conveyed, as is most justly due, to all the gentlemen named.

The collections sent by Messrs. Annandale, Bayon, Dudgeon, Graham, Horton, O'Brien, Pratt, Wenyon, and Wise, were large and varied; those from Mr. Pratt deserve particular notice on account both of their extent and of the unusual care that had been bestowed upon them; those presented by Dr. Annandale, Mr. Dudgeon, and Dr. Graham, are peculiarly valuable as they consist entirely of well-mounted and authoritatively-named specimens, most of which represent species of great practical importance.

Under the heading of *Acquisitions*, special mention must be made (*a*) of a complete series of the "Fauna of British India," presented by the Right Honourable the Secretary of State for India—a very valuable donation; and (*b*) of a copy of the "Catalogue of Snakes," most kindly presented by the Trustees of the British Museum.

4. *The Collections*:—

- (A) *The Reference Collection*, which consists of well-preserved and authentically-named specimens grouped geographically, has steadily increased.
- (B) *The Teaching Collection* has been much extended and elaborated, so that students now have access to a considerable number of named species, which they can study at leisure. This I regard as the beginning of an ideal state of affairs when every student can handle and become familiar with every species that is known to have any important connection with tropical medicine.

5. *Teaching*.—During the summer session I gave the usual course of lectures and demonstrations upon (*a*) arthropoda, and (*b*) venomous snakes. I have also added to the series of diagrams and preparations for illustrating these courses. One student came for special instruction in the subject of venomous snakes.

6. *Correspondence, &c.*—A certain number of identifications of specimens has been made for correspondents; among them that of a fly of the family *Dolichopodidæ*, which was reported by Dr. J. M. Atkinson, of Hong Kong, to be predaceous upon mosquito larvæ. Dr. Atkinson proposes to pay further attention to this matter and hopes at the proper season to send some well-preserved specimens of this fly for specific determination.

A. ALCOCK, Lt.-Col.,
Indian Medical Service (Retired).

Enclosure 2 in No. 2 in Appendix V.

HALF-YEARLY REPORT OF HELMINTHOLOGIST TO 31ST OCTOBER, 1908.

SIR, London School of Tropical Medicine (Helminthological Department),
Royal Albert Dock, E., 1 November, 1908.

I HAVE the honour to submit my report, for the half-year ending 31st October, 1908, upon my work as Helminthologist to the London School of Tropical Medicine, and to forward herewith reprints of papers published by me during the same period, viz.:—

- (1) The occurrence of a rare Sclerostome of Man in Nyasaland.—“Journal of Tropical Medicine and Hygiene,” June, 1908.
- (2) *Physaloptera mordens*: a new intestinal parasite of Man.—“Transactions of the Society of Tropical Medicine,” July, 1908.
- (3) Note on the anatomy of *Cystidicola farionis*.—“Parasitology,” Vol. 1, No. 2, June, 1908.
- (4) Some Generic Names that have been omitted from recent Zoological indices.—“The Zoologist,” October, 1908.
- (5) Generic Names of Polychæt Worms that have been pre-occupied and remain unreplaced.—In the “Annals and Magazine of Natural History,” November 1st, 1908.

The following paper has been completed and is now passing through the Press:—

- (6) An account of some Helminthes contained in Dr. C. M. Wenyon's Collection from the Sudan.—For the Gordon College Laboratories Report, Vol. III.

Papers are now being prepared upon the following subjects and will put on record work actually concluded during the period of this report:—

- (7) A collection of parasitic Nematode Worms from the Swedish Zoological Expedition, under Professor Sjosjedt, of Stockholm, to Kilimandjaro and German East Africa.—For the Transactions of the Konigl. Schwedische Akademie der Wissenschaften.
- (8) The relationship of the human Gnathostoma to other species of the genus.
- (9) *Lagochilascaris minor*—a new and aberrant parasite of Man.

The nature of the contents of the above papers may be briefly indicated.

New observations upon human helminthes are recorded in Nos. (1), (2), (8), (9).

In No. 1 the *Triodontophorus deminutus*, a parasite closely related to the ankylostomes, is figured for the first time and the original description of its characters is in some respects amended.

Nos. 2 and 9 deal with forms new to science.

No. 8 describes the hitherto unknown male of *Gnathostoma siamense* and discusses whether man is the normal host of this parasite.

Nos. 3, 6, 7, describe collections from the lower animals and establish several new forms.

Nos. 4, 5, are compilations that, it is hoped, may be of value to nomenclaturists and others working in the special department of zoology with which they deal. The determination of the many diverse helminthic parasites that are sent from abroad to the Tropical School necessitates many visits to the large scientific libraries in the City. Not infrequently these journeys prove fruitless of their special purpose, and in order that the time so taken up might not be absolutely wasted, I have been in the habit of making jottings of “worm” literature. From such intermittently collected notes these and similar compilations are formed.

OTHER INVESTIGATIONS.

Progress has been made with the reports upon the collection of animal parasites made during my recent visit to Uganda and other material received during the past year, but on more than one occasion this work has been laid aside to allow of advantage being taken of fresh material from the wards that had a more direct bearing upon tropical disease and prophylaxis. Investigations upon *Fasciolopsis*

buski, *Schistosomum hæmatobium*, and *Strongyloides stercoralis* are still proceeding, but the following statements may be made of conclusions already arrived at concerning the propagation and development of the last-named parasite.

(1.) The embryos of *Strongyloides stercoralis* (*Anguillula intestinalis*) do continue to develop in undiluted fæces and become metamorphosed into filariform larvæ directly and also into sexual forms. The filariform larvæ survive about a fortnight, but undergo no further development.

(2.) The sexual forms can live and propagate in putrescent fluids.

(3.) The differentiation into filariform larva or sexual adults does *not* seem to be determined by differences of temperature.

(4.) The adult sexual forms propagate and give rise to many generations that live saprophytically, and do not require a return to the parasitic existence in the human intestine in order to ensure the continuation of the life cycle. Leichtenstern and others have shown that the sexual extra-corporeal stage is not a necessity in the continuation of the hermaphroditic form. From our observations it would appear that the parasitism of man is, to some degree at least, likewise facultative.

The power of the sexual stage to continue its existence indefinitely outside the human body may explain the widespread nature of the infection in tropical lands. It also points to the necessity of a stringent application of laws relating to excreta disposal in infected countries. The importance of such measures in the reduction of ankylostomiasis has recently been strongly urged. The *Strongyloides intestinalis* and ankylostomes are very commonly found in the same individual so that measures designed to stamp out the one disease would necessarily lead to a diminution in the other.

TEACHING.

Four lectures and a laboratory course extending over three weeks were given by me during the summer season. The lecture syllabus and scheme of practical work followed closely upon the lines detailed in my last report.

HELMINTHOLOGICAL MUSEUM.

Considerable additions have been made to the collection of the helminthic parasites of man and the lower animals. Our thanks are due to the following for valuable specimens received during the past six months:—

Dr. Bancroft, Australia.
 Dr. Bayon, Uganda.
 Dr. C. W. Branch, West Indies.
 Mr. Haines, South Africa.
 Mr. Hewitt, Federated Malay States.
 Dr. Jeffreys, China.
 Dr. A. F. G. Kerr, Siam.
 Dr. Low, London.
 Dr. Maxwell, Formosa.
 H. C. Pratt, Esq., Kuala Lumpur.
 Dr. P. H. Ross, British East Africa.
 Dr. Sells, Uganda.
 Professor Sjosjedt, Sweden.
 E. A. Shipley, Esq., Cambridge.
 R. Stordy, Esq., British East Africa.
 Dr. Turner, Transvaal.
 Dr. Wellington, Singapore.
 Dr. Wenyon, London.
 Dr. Whyte, China.
 Dr. Wise, British Guiana.

I am also greatly indebted to Dr. C. W. Daniels for his active endeavours to obtain me much needed material in special lines of investigation.

I have, &c.,
 ROBERT T. LEIPER.

Enclosure 3 in No. 2 in Appendix V.

REPORT OF PROTOZOOLOGIST FOR SIX MONTHS ENDING 31 OCTOBER, 1908.

London School of Tropical Medicine,

Royal Albert Dock, E., 1 November, 1908.

During the period covered by this report I have been chiefly occupied in studying the material I had collected in the Anglo-Egyptian Sudan when I was acting as travelling pathologist and protozoologist to the Sudan Government in connection with the Wellcome Research Laboratories of the Gordon College, Khartoum. The results of these investigations are shortly to appear in the third volume of Reports of the Wellcome Research Laboratories, and owing to the courtesy of Mr. Wellcome, under whose patronage the reports are issued, I am able to forward a confidential advance proof of my contribution to this volume. The advance proof contains the results of my investigations on my Sudan material. The report commences with an introduction in which are described the main features of my work in the Sudan and the course taken on the Nile and its tributaries illustrated by an accompanying map and views of the Floating Laboratory.

The introduction is followed by a discussion of certain human conditions which I was able to study. Dysentery and dracontiasis are the chief of these. In the former I have followed out the course of development of *Entamoeba coli*, and found it to correspond with the description given by Schaudinn and the life cycle of the amoeba of the mouse, described by me in an earlier publication. Under the heading Dracontiasis are recorded certain experiments I conducted with cyclops and guinea worm embryos, the results of which are in complete agreement with those obtained by Dr. Leiper when working at the same subject on the West Coast of Africa.

Trypanosomiasis in Domestic Animals.—In this section are recorded my experiences of diseases of domestic animals caused by trypanosomes. In the southern parts of the Sudan in which I travelled there appear to be two types of trypanosomiasis caused by two distinct trypanosomes. One of these is *Trypanosoma pecaui*, which is probably transmitted by *Glossina morsitans*, and is the cause of the death of numbers of cattle and transport animals in the Bahr el Ghazal Province. This trypanosome is easily inoculable into small mammals such as rats. The second trypanosome is *Trypanosoma nanum* which may be found in districts free from *Glossina*, and so must be transmitted by some other agent. *Trypanosoma nanum* occurs naturally in cattle, and the small trypanosome of mules and donkeys is probably identical with it. This trypanosome is only exceptionally transmitted to rats by inoculation. It will, however, infect dogs.

Some experiments were made in the treatment of trypanosomiasis, and good results were obtained with soamin in the treatment of *Trypanosoma pecaui*. These experiments are still in progress, and have been extended to *Trypanosoma gambiense*.

A section is devoted to the consideration of trypanosomes and another to flagellates in biting flies. In both these sections new parasites have been recorded, but as they are fully described in the accompanying report they need not be mentioned here.

Hæmoproteus agamæ, a halteridium of a lizard, *Hæmocystidium najae*, a pigmented parasite within the red blood cells of the cobras *Naja hajæ* and *Naja nigricollis*, *Babesia avicularis*, a piroplasma of the zebra mouse, *Hæmogregarina gracilis* of a lizard with interesting developmental forms of the hæmogregarine in the liver, *Plasmodium mabuia*, a proteosoma-like parasite of a lizard together with other parasites hitherto unrecorded will be found described in the latter parts of the report.

One section is devoted to the consideration of the leucocytozoon of the guinea-fowl on account of certain results I have obtained in its investigation which throw light on the relation supposed by some to exist between the intracorpuseular parasites and the flagellata. It is shown that Schaudinn and those who have followed him are in error in at least part of the doctrines they enunciate.

The above is a brief outline of the subject matter of the accompanying report, a reference to which will give any further details which are not mentioned here.

During the past six months I have taken a share in the teaching of protozoology in the school; this has consisted in lectures and demonstrations in which representatives of the main groups of protozoa have been studied, and more especially the amoebæ, flagellata, and sporozoa. The methods of studying these protozoa both in

the living and dead state, the relation of the human parasitic forms to those occurring in lower animals, and the bearing the latter have on human protozoology have been subjects of special consideration.

C. M. WENYON.

APPENDIX VI.

No. 1 in Appendix VI.

THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 1 May, 1908.)

SIR,

B 10, Exchange Buildings, Liverpool, 30 April, 1908.

I HAVE the honour to enclose the following reports, showing the manner in which the Government grant to the Liverpool School of Tropical Medicine has been expended in the six months ending 30th April, 1908, viz.:—

1. Report of the Walter Myers Lecturer in Tropical Medicine. (Dr. J. W. W. Stephens.)
2. Report of the Director of the Runcorn Research Laboratories. (Dr. A. Breinl.)
3. Report of the Lecturer in Economic Entomology and Parasitology. (Mr. R. Newstead.)

With regard to the enclosures, which accompany the report of the Lecturer in Economic Entomology and Parasitology, I am to ask that they may not be published at present.

I have the honour to report that the School has at present three expeditions at work, viz.: A Yellow Fever Expedition, despatched to Manàos in April, 1905; a Sleeping Sickness Expedition, despatched to Rhodesia in May, 1907; and a Black-water Fever Expedition, despatched to Central Africa in August, 1907.

A movement is on foot to commemorate the death of Dr. Dutton (who lost his life whilst serving on an expedition of the School, from spirillum fever, which disease he was investigating at the time) by the establishment of a Chair of Economic Entomology and Parasitology in the University of Liverpool in connection with the School. Promises amounting to £7,000 have already been given towards the establishment of the Chair.

The publications of the School are now issued in the form of "Annals of Tropical Medicine and Parasitology," copies of which, when issued, are forwarded to the Colonial Office for transmission to the various Colonies, contributing to the funds, at the disposal of the Tropical Diseases Advisory Committee.

I have, &c.,

A. H. MILNE,

Secretary.

Enclosure 1 in No. 1 in Appendix VI.

B 10, Exchange Buildings, Liverpool, 30 April, 1908.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE.

SIR,

I BEG to submit the following report on the work done during the period from November 1st, 1907, to April 30th, 1908.

Students.

The number of medical men who attended the Autumn Term was 7, and the number for the Lent Term was 15, total 22. Of these, 2 belonged to the Indian Medical Service; 2 to the Royal Army Medical Corps; 6 to the West African Medical Staff; 4 to the Colonial Service; 8 Miscellaneous.

Diploma of Tropical Medicine.

The number of candidates who entered for the examination in December, 1907, was 6, of whom 5 passed. The number of candidates for the March examination was 11, of whom 10 passed.

Absence of the Professor of Tropical Medicine.

During the absence of Major Ross in Mauritius I was appointed by the Committee of the School to take on his duties and to deliver his systematic lectures on tropical medicine. The extra work involved by this has entirely precluded my attempting to do any research work during this period, and, in addition to the actual teaching work, the whole of the administration of the School devolved upon myself. In carrying out the teaching I had the assistance of Dr. J. A. Allwood, whose services were kindly lent by the Colonial Office during this period, and without whose valuable aid it would have been quite impossible to have got through the practical teaching.

The Museum.

The thanks of the School are due to the following gentlemen for specimens sent to the School during the last six months:—

Major Donovan, Indian Medical Service, Madras; Dr. A. S. Donaldson Broomassie Mine, Gold Coast; Major Robertson Milne, Indian Medical Service, Bengal; Dr. Renner, Freetown; Dr. Kennan, Freetown; Captain Steen, Indian Medical Service, Sylhet; Dr. Jackson Moore, Sierra Leone; Dr. H. Wolferstan Thomas, Amazon Expedition; I. G. Middleton, Esq., Bengal; Major Maddox, Indian Medical Service, India; Dr. J. S. Taylor, Grenada; Major C. L. Williams, Indian Medical Service; Dr. Chisholm, North-East Rhodesia; Dr. Pailthorpe, Almora, India; Captain Maddock, Indian Medical Service, Kanara, India; R. T. Young, Esq., State University of North Dakota; Dr. Bell, Hong Kong; Dr. Campbell, Madras; Dr. Savas, Greece; Dr. Pickels, Southern Nigeria; Dr. Bremner, Southern Nigeria; Dr. W. I. Taylor, Lagos; Dr. Arnold, Pretoria; Professor Ross; Dr. Musgrave, Manila; Dr. Cardamatis, Greece; Dr. Camerano, Turin.

Franco-British Exhibition.

In response to a request from the Exhibition authorities the Committee of the School willingly decided to prepare an exhibit illustrating tropical medicine. Owing to the small space assigned by the authorities it was impossible to make the exhibit a thoroughly representative one, and consequently it was decided to confine the exhibit to specimens illustrating tropical diseases and the mode of their transmission by mosquitoes, tsetse flies, fleas, ticks, and other blood-sucking animals. The Lecturer on Economic Entomology has described these specimens that have been specially prepared by him for this purpose. The other specimens in the exhibit were selected from specimens in the museum of the School, and it is a matter for regret that owing to the limited space it was possible to show so little of the collection now in the possession of the School. It was thought best that the nature of the exhibit should be of a semi-popular description.

Annals of Tropical Medicine and Parasitology.

Nos. 3 and 4 of Vol. I., and No. 1 of Vol. II. of this journal have been published and contain the following articles:—

No. 3, Vol. I.:—

Concerning certain Parasitic Protozoa observed in Africa, by J. E. Dutton, J. L. Todd and E. N. Tobey.

Yaws, by C. W. Branch.

A description of some Gold Coast Entomostraca, by W. M. Graham.

Notes on Dr. Graham's Collection of Cyclopidae from the African Gold Coast, by G. S. Brady.

On the Morphology and Life History of *Spirochaeta duttoni*, by A. Breinl.

The Cytology of the Trypanosomes, by Professor J. E. Salvin-Moore and Dr. A. Breinl.

No. 4, Vol. I.:—

Observations on the so-called "Canary Fever," by C. E. Walker.

Contribution à l'Etude de *Porocephalus moniliformis*, by A. Broden et J. Rodhain.

On the Habits, Life-Cycle and Breeding Places of the Common House-Fly (*Musca domestica*, Linn.), by R. Newstead.

Some Notes on the Morphology of *Spirochaeta duttoni* in the Organs of Rats,
by J. J. van Loghen.

Malaria and History, by W. H. S. Jones.

Two New Human Cestodes and a New Linguatulid, by J. W. W. Stephens.

No. 1, Vol II. :—

Atoxyl and Trypanosomiasis, by Sir Rubert Boyce and Dr. Anton Breinl.

My Experience of Trypanosomiasis in Europeans and its Treatment by
Atoxyl and other Drugs, by Sir Patrick Manson.

We think we may justly claim that the standard of the articles in the first volume has been a high one, and that the Annals have met with a large support.

The Library.

The following books have recently been added to the library :—

System of Medicine, Vol. 2, part 2, Allbutt and Rolleston.

Tropical Diseases, 4th edition, Sir Patrick Manson.

Practical Study of Malaria and other Blood Parasites, 3rd edition, Stephens and Christophers.

Fevers in the Tropics, Leonard Rogers, Indian Medical Service.

Mycetoma, or the Fungus Disease of India, Vandyke Carter.

Pathogenen Protozoen, 2nd part, Wasielewski.

Trypanosomes and Trypanosomiasis, Laveran, translated by Nabarro.

I am, &c.,

J. W. W. STEPHENS,

The Secretary, Walter Myers Lecturer in Tropical Medicine.
The Incorporated Liverpool School of Tropical Medicine,
Liverpool.

Enclosure 2 in No. 1 in Appendix VI.

The Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool, 30 April, 1908.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE.

DEPARTMENT OF THE DIRECTOR OF THE TROPICAL RESEARCH LABORATORIES,
RUNCORN.

SIR,

As requested, I have the honour to report in brief on the research work which has been carried out at the Runcorn Research Laboratories of the Liverpool School of Tropical Medicine during the six months ending 30th of April, 1908.

During this time, the outfit of the laboratory has been completed; a chemical department with all the necessary apparatus, &c., has been attached to the laboratory, and, at the same time, all the necessary appliances for modern immunity work have been installed, so that the apparatus at the disposal of the laboratory at present permits any kind of modern work.

The following have worked in the laboratory during the named period, viz., Dr. A. Breinl, Director, Dr. M. Nierenstein, and Mr. E. Hindle, and three specially trained laboratory assistants.

1. Breinl and Hindle studied the morphology of *Piroplasma canis*; they have been able, with the aid of new methods, to work out the nuclear details of this parasite. It has been found that the parasites at certain phases of the disease are very large and possess 1-2 flagella; these forms, however, are very different from typical trypanosomes. Their nature and morphological meaning will be cleared up by further work, tracing the life-history of the parasites through the tick, which is the intermediate host. The results will be published shortly.

2. Breinl, in collaboration with Professor J. E. S. Moore, of the Cytological Department of the University of Liverpool, has continued the studies on the morphology of trypanosomes. One paper dealing with the life-history of *Trypanosoma equiperdum* has been read before the Royal Society.

T. equiperdum, which usually does not require an intermediate host, has been shown to possess a complete life-history in experimental animals, analogous to that of *T. gambiense*.

A study of *T. lewisi*, which has not been completed, shows that this parasite has a similar life-history.

3. Dr. Nierenstein has begun chemical studies of atoxyl and trypanosomiasis.

He was able to prove that, during the course of an infection with trypanosomes, the total acidity of the blood serum shows a marked increase, whereas the total alkalinity remains constant.

His pharmacological study of atoxyl has revealed very important facts. Some experiments, in collaboration with Breinl, concerning the preventative action of a mixture of blood, heavily infected with trypanosomes, and strong solutions of atoxyl, showed that atoxyl in vitro has very little action on trypanosomes, as donkeys, dogs, and rabbits injected with this mixture became infected with trypanosomes after a more or less prolonged incubation period, and died. It was thought, therefore, that the action of atoxyl upon the trypanosomes must be a cell re-action, and must differ from the action of sodium arsenate. Atoxyl by itself has been found to have no preventative action whatsoever.

Nierenstein has been able to demonstrate further, that it is through the amido (NH_2) group that atoxyl combines with the proteids. Similar compounds to atoxyl without this group showed a different behaviour in vitro, as no combination with the proteids took place. At the same time, the curative property of these latter compounds has been shown to be very unsatisfactory.

These results are the more important, as they show the direction in which atoxyl might be improved and be made a more powerful trypanocidè.

A preliminary note on his results will appear shortly in the *Annals of Tropical Medicine*.

4. Breinl has been working on trypanosomiasis treatment experiments on monkeys, donkeys, horses, and small animals. He has been able to confirm Plimmer and Thompson's important discovery of the action of sodium antimonyl tartrate, a powerful trypanocidè. However, no lasting cures could be effected. This observation has been published in brief in a paper with Sir R. Boyce on the progress of Sleeping Sickness Treatment during the year 1907. Analogous compounds to atoxyl possessing instead of an aniline a toluidine nucleus have been thoroughly tested, and one compound, *Asodyl*, has been found very effective in the treatment of *T. gambiense* and *T. equiperdum*, although it has no effect on *T. brucei*.

The action of atoxyl in combination with different mercury compounds on numerous monkeys infected with *T. gambiense* has proved very satisfactory up to the present. All these observations are, however, still incomplete.

5. Breinl and Hindle have been able to infect a goat with "Heart-Water" through ticks sent from South Africa by Mr. Lounsbury. An etiological study of this disease has been begun, but has revealed nothing striking up to the present.

The following is a list of the publications issued since October 1st, 1907, from this laboratory :—

Concerning certain parasitic protozoa observed in South Africa, by the late Dr. J. E. Dutton, Dr. J. L. Todd, and Dr. E. N. Tobey. *Annals of Tropical Medicine and Parasitology*, Vol. I., No. 3, November, 1907.

On the morphology and life-history of *Spirochaeta duttoni*, by Dr. A. Breinl. *Annals of Tropical Medicine and Parasitology*, Vol. I., No. 3, November, 1907.

The Cytology of Trypanosomes, Part I., by Professor J. E. Salvin-Moore and Dr. A. Breinl. *Annals of Tropical Medicine and Parasitology*, Vol. I., No. 3, November, 1907.

Some notes on the Morphology of *Spirochaeta duttoni* in the organs of rats, by Dr. J. J. van Loghem. *Annals of Tropical Medicine and Parasitology*, Vol. I., No. 4, February, 1908.

Atoxyl and Trypanosomiasis, by Sir R. Boyce and Dr. A. Breinl. *Annals of Tropical Medicine and Parasitology*, Vol. II., No. 1, March, 1908.

I am, &c.,

ANTON BREINL,

Director of the Research Laboratories,
Runcorn.

The Secretary,

The Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings,
Liverpool.

Enclosure 3 in No. 1 in Appendix VI.

The Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool,

DEPARTMENT OF ECONOMIC ENTOMOLOGY AND PARASITOLOGY.

SIR,

I HAVE the honour to submit the following report on the work of this Department during the six months November, 1907, to April, 1908, inclusive:—

The number of medical and veterinary students who attended the course in Economic Entomology was:—

Term commencing October 1st	...	...	...	10
Term commencing January 14th, 1908	...	...	...	19
Total				29

The number of candidates who entered for examination was 18, of whom 16 passed.

The usual number of lectures was given, the lectures being followed by a practical demonstration and examination of all the important blood-sucking arthropoda, and as far as the material at hand permitted, of the developmental stages also.

Papers published.

1. On the habits, life-cycle and breeding places of the Common House-fly (*Musca domestica*, Linn). This report has been republished in the Annals of Tropical Medicine and Parasitology of this School. It is a reprint of the paper issued privately by the Health Department of the City of Liverpool. A summary of this work, together with a copy of the full report, was forwarded with my last report to the Colonial Office.

There has been a great demand for copies of this report both at home and abroad, and a large number have been distributed gratuitously. The Governor of the Imperial Department of Agriculture for the West Indies, in a letter to Sir Alfred Jones, K.C.M.G., has expressed a desire to reprint a summary of the work in "The Agricultural News" of that country.

2. On the structural characters of three species of Coccidæ affecting cocoa, rubber and other plants in Western Africa. With 22 figures in the text. This paper was published in the "Journal of Economic Biology." A reprint is submitted herewith. It deals with three species, two of which are new to science. *Stictococcus sjostedti* is an insect of considerable economic importance, as it may, if left unchecked, prove a serious pest to the cultivated cocoa.

3. On the scale insects and mealy bugs of Egypt.

4. On the Gum-lac of Madagascar and other Coccids affecting the citrus and tobacco in that island. With 21 figures in the text. Copy of report submitted herewith.

5. Additions to Wild Fauna of the Royal Botanic Gardens, Kew. With 4 figures in the text. Copy of "Kew Bulletin" (No. 3, 1908) submitted herewith. This paper contains the description of a species of plant louse new to Britain and also a list of the scale insects (Coccidæ) found infesting the cultivated and other plants and trees in the Royal Gardens.

Papers completed but awaiting publication.

6. On two new anopheline mosquitoes:—

(1) *Cellia* n. sp. Described from material (eggs, larvæ, and adults) collected in the Transvaal by Dr. F. Arnold.

(2) *Pyretophorus* n. sp. Described from material collected in the Transvaal by Dr. F. Arnold.

7. On some homopterous insects collected by Dr. Yngve Sjostedt during his expedition to Kilimanjaro, East Africa. With 31 figures in the text. This paper is already in type and will be published shortly in the Proceedings of the Royal Swedish Academy of Science, Stockholm. It embraces the descriptions of six species new to science.

8. On a collection of homopterous insects affecting cocoa, cotton, rubber, pepper and other plants in the Cameroons and elsewhere. With three plates. This paper has been forwarded to Dr. W. Busse, of the Kaiserliche Biologische Anstalt für Land und Forstwirtschaft, Dahlem. It contains descriptions of one genus and six species new to science.

9. On the Brown Scale of the Gooseberry, &c. (*Lecanium ribis*). This paper will be issued by the Board of Agriculture and Fisheries.

Papers in the course of preparation.

1. Report on the food of some British Birds in relation to Agriculture and Horticulture. This work is based on nearly a thousand post-mortem examinations of various species of birds conducted during the years 1888-1904. When completed this report will be published by the Board of Agriculture and Fisheries.

Museum.

Preparation of Blood-sucking Insects and Ticks for Exhibition and Study.

The following preparations have been specially prepared by myself for the Franco-British Exhibition to be held in London in 1908. These preparations will be added to the Museum of this School on the termination of the exhibition:—

1. *Sleeping Sickness*.—Developmental cycle of the tsetse fly *Glossina palpalis*; with map showing the distribution of the insect in space; descriptive labels; photographs of natives of the Congo Free State illustrative of the various phases of the disease.

2. *Yellow Fever*.—Specimens illustrating the developmental cycle of the yellow-fever mosquito (*Stegomyia fasciata*). Map showing distribution in space; enlarged coloured drawing of the female and egg.

3. *Malaria*.—A series of the anopheline mosquitoes that are known to transmit malaria in Africa, India, and Europe.

4. *Elephantiasis*.—Specimens of some of the mosquitoes that transmit filarial disease, which not uncommonly shows itself as elephantiasis.

5. *Bubonic Plague*.—Mounted specimens of the three common species of rats concerned in the dissemination of this disease. *Mus rattus rattus*, *Mus rattus alexandrinus*, and *Mus decumanus*, together with the skulls of these animals showing the dentition, &c.

6. *Bubonic Plague*.—The rat, or plague flea, *Pulex (Læmopsylla) cheopis*, male and female; together with an enlarged drawing of the male and the salient anatomical characteristics of this insect.

7-8. *Myiasis* (two cases).—Examples of the screw worm (*Comptosomyia macellaria*), together with photographs of the two patients from which the insects were taken.

9. *Myiasis*.—Examples of the Congo floor maggot (*Auchmeromyia luteola*), together with the pupæ and imagines of the insect; coloured and plain drawings of the larva, &c.; descriptive label.

11. *African Relapsing Fever*.—Mounted preparations of a tick (*Ornithodoros moubata*) and its developmental stages; enlarged drawings of egg larva nymphs and adult. Map showing distribution. Descriptive label.

12. The common house fly (*Musca domestica*); illustrating the developmental cycle, &c.; descriptive label.

13-16. Four separate cases devoted to examples of pathogenic ticks, with drawings, &c., and descriptive label.

17-23. Jars containing mounted examples of African and other ticks concerned in the dissemination of disease in domestic animals.

In addition to the preparations of these exhibits, material assistance has also been rendered in the preparation and arrangements of other exhibits.

Additions to the collections.

The Entomological Department had been considerably enriched by collections of insects, ticks, &c., from India, Ceylon, Africa, Manaois, British Honduras, Hawaii and Mauritius.

Several small collections of mosquitoes and other biting flies and ticks from India, West Coast of Africa, Egypt, Cyprus and Greece, have been identified for various correspondents and former students of this School.

I have, &c.,

ROBT. NEWSTEAD,
Lecturer in Economic Entomology and
Parasitology, &c.

The Secretary,

The Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings,
Liverpool.

No. 2 in Appendix VI.

THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL
OFFICE.

(Received 31 October, 1908.)

SIR, B 10, Exchange Buildings, Liverpool, 30 October, 1908.

I HAVE the honour to enclose, for the information of the Tropical Diseases Advisory Committee, the following reports of the Liverpool School of Tropical Medicine for the six months ending 31 October, 1908, viz.:—

- (1) Report of the Walter Myers Lecturer of the School (Dr. J. W. W. Stephens).
- (2) Report of the Director of the Runcorn Research Laboratories of the School (Dr. A. Breinl).
- (3) Report of the Lecturer in Economic Entomology and Parasitology (Mr. R. Newstead).

It will be of interest to the Committee to learn that the following expeditions of the School are at work at present, in the countries named, viz.:—

- (a) Yellow Fever Expedition (Dr. H. Wolferstan Thomas) in Brazil.
- (b) Sleeping Sickness Expedition (Dr. A. Kinghorn and Mr. R. E. Montgomery) in Rhodesia and Nyassaland.
- (c) Blackwater Fever Expedition (Dr. Barratt and Dr. York) in British Central Africa.

In addition, another expedition of the School will proceed to Jamaica on the 14th November, consisting of Mr. R. Newstead, A.L.S., F.E.S., Dr. W. T. Prout, C.M.G., and Dr. A. Hanley, C.M.G. This is the twenty-first research expedition despatched to the tropics by the Liverpool School of Tropical Medicine.

I am, &c.,

A. H. MILNE,
Secretary.

Enclosure 1 in No. 2 in Appendix VI.

B 10, Exchange Buildings, Liverpool, 30th October, 1908.

Department of Walter Myers Lecturer in Tropical Medicine.

SIR,

I BEG to submit the following report on the work done during the period from 1 May to 31 October, 1908.

Students.

The number of medical men who attended the summer term was 13, and the number for the autumn term, 11. Total, 24.* Of these four belonged to the Indian Medical Service; one to the Royal Army Medical Corps; one to the West African Medical Staff; one to the Colonial Medical Service; 17 miscellaneous, among which the following localities were represented: Bombay, Columbia, Assam, Montana, Batavia, Burma, British Honduras, Trinidad.

Diploma of Tropical Medicine.

The number of candidates who entered for the examination in July was six, of whom five passed.

Museum.

The thanks of the School are due to the following gentlemen for their kindness in sending specimens to the School during the last six months:—

Colonel Adie, I.M.S., Ferozepore; Major Maddox, I.M.S., India; Mr. Joseph Sturge, Montserrat; Dr. J. B. Bate, Southern Nigeria; Dr. Andrew Balfour, Khartoum; Dr. Bell, Hong Kong; Dr. Cardamatis, Athens; Major Glen Liston, I.M.S., Bombay; Dr. Bremner, Nigeria; Dr. Campbell and Dr. J. J. Thomson, Jammalamadugu; Dr. H. Wolferstan Thomas, Amazon Expedition; Mr. R. Newstead; Professor Ross; Monsieur d'Emmerez de Charmoy, Mauritius; Dr. Pickels, Nigeria; Dr. C. J. Macalister, Royal Southern Hospital; Professor Thelwall Thomas, Royal Infirmary, Liverpool; Dr. Duncan White, China; Dr. Donaldson, Broomassie; Dr. Flannagan, Virginia; Dr. Kennan, Freetown.

* * * * *

Extended Course of Instruction.

The new course of instruction which has been decided upon will come into force in January, 1909. This course will be as follows:—

Full course begins 6 January. Diploma examination 5 April.

Short course begins 1 June. Certificate examination 29 June.

Full course begins 15 September. Diploma examination 13 December.

The fee for the full course will be raised, in accordance with the extension, to 13 guineas, while the fee for the short course will be four guineas.

Research Work.

During the summer term I have been investigating the anatomy of some new human nematodes received from Hong Kong, and I shall publish a description of these in the next number of the "Annals of Tropical Medicine and Parasitology."

In September I read a paper before the zoological section of the British Association at Dublin on the "Cultivation of Amœbæ."

J. W. W. STEPHENS,

The Secretary,
The Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings,
Liverpool.

Enclosure 2 in No. 2 in Appendix VI.

B 10, Exchange Buildings, Liverpool, 30 October, 1908.

Department of the Director of the Tropical Research Laboratories, Runcorn.
SIR,

As requested, I have the honour to report in brief on the research work which has been carried out at the Runcorn Research Laboratories of the Liverpool School of Tropical Medicine, during the six months ending 30 October, 1908.

The money was largely utilised in assisting the current expenses of the laboratory, particularly in the purchase and maintenance of the large number of experimental animals which have been used for experimental work on sleeping sickness, especially on treatment with different drugs.

The staff of the laboratory consisted during the said period of Dr. Anton Breinl, Director, Dr. Max Nierenstein, and Mr. E. Hindle, and three specially trained laboratory assistants.

I. The study of the life-history of *Trypanosoma lewisi* by Breinl and Hindle, in collaboration with Mr. Salvin-Moore, of the Liverpool University, was continued. They were able to prove that *Trypanosoma lewisi* has an analagous life-history to

Trypanosoma gambiense and *Trypanosoma equiperdum*, with the only difference that nearly all the stages of the life-history can be seen during practically the whole period of infection in the peripheral blood. They were able to show further that the interaction between the nucleus and the blepharoplast, as found in *Trypanosoma gambiense* and *Trypanosoma equiperdum*, takes place in a similar way. Afterwards, the trypanosomes grow and give rise to a varying number of small forms.

At present, Breinl and Hindle are tracing the life-history of *Trypanosoma lewisi* through the rat louse, which acts as the natural intermediary host. This work, however, has not come to a definite issue up to the present, but has progressed as far as to promise good results.

II. M. Nierenstein has continued his pharmacological study of atoxyl and allied compounds. He has been able to demonstrate the changes which atoxyl undergoes in the animal body, also in which form atoxyl is secreted in the urine. He has further proved that if large initial doses of the drug are given, nearly the whole amount of arsenic is secreted in the urine.

He was able to show that atoxyl acts *in vivo* in practically the same way as *in vitro*, i.e., atoxyl, after its administration to experimental animals, combines with the proteids of the serum.

III. M. Nierenstein has put a great deal of energy on the preparation of organic antimony compounds which might be used for sleeping sickness treatment.

Plimmer and Thompson's finding of the rapid trypanocidal action of sodium-antimonyl-tartrate drew the general attention to the fact that antimony is at least as powerful a trypanocide as arsenic. On the other hand, the local lesions which followed the administration of this drug prevented its practical application for sleeping sickness treatment.

M. Nierenstein has succeeded in preparing some new organic antimony compounds, which, in the preliminary experiments, have given encouraging results, and will be tried on a larger scale on animals infected with the different trypanosome strains.

A. Breinl is continuing his observations on monkeys infected with *Trypanosoma gambiense* and treated with acetylated atoxyl and mercury combined. Nearly all the monkeys are still alive, and have been free of parasites for over four months. This observation proves again the superiority of the combined treatment with atoxyl and mercury over the treatment with atoxyl alone.

A. Breinl has continued his study of the action of different arsenic compounds on infected animals, but has not been able to prove experimentally that any of the newly prepared arsenic compounds show any superiority over atoxyl.

IV. Breinl and Hindle are continuing the morphological study of the life-history of *Spirochaeta duttoni* in the tick *Ornithodoros moubata*.

V. Breinl and Hindle are continuing the morphological work on the different strains of pathogenic trypanosomes.

The following is a list of the publications issued since April from the Institute.

The life-history of *Trypanosoma equiperdum* by J. E. S. Moore and Anton Breinl. Proceedings of the Royal Society, B., Vol. 80, 1908.

Weitere Beobachtungen über Atoxylfestigkeit der Trypanosomen, von A. Breinl und M. Nierenstein. Deutsche medizinische wochenschrift, No. 27, 1908.

The life-history of *Trypanosoma lewisi*, by J. E. Salvin-Moore, Anton Breinl, and Edward Hindle. Annals of Tropical Medicine and Parasitology, Vol. II., No. 3, p. 197, July, 1908.

Comparative Chemo-therapeutical Study of Atoxyl and Trypanocides, by M. Nierenstein, Ph.D. Annals of Tropical Medicine and Parasitology, Vol. II., No. 3, p. 249, July, 1908.

Contributions to the Morphology and Life-history of *Piroplasma canis*, by Anton Breinl and Edward Hindle. Annals of Tropical Medicine and Parasitology, Vol. II., No. 3, page 233, July, 1908.

Concerning the Treatment of Experimental Trypanosomiasis, by Benjamin Moore, M. Nierenstein, and John L. Todd. Annals of Tropical Medicine and Parasitology, Vol. II., No. 4, 1908.

Notes on the effects of therapeutic agents on trypanosomes in respect to (a) acquired resistance of the parasites to the drug; and (b) changes in virulence of the strains after escape from the drug, by Benjamin Moore, M.A., D.Sc. (R.U.I.), Max. Nierenstein, Ph.D., and John L. Todd, B.A., M.D. (McGill), M.R.C.S. Annals of Tropical Medicine and Parasitology, Vol. II., No. 3, p. 221, July, 1908.

Observations on the Acidity and Alkalinity of the Blood in Trypanosome Infections, by M. Nierenstein, Ph.D. *Annals of Tropical Medicine and Parasitology*, Vol. II., No. 3, p. 277, July, 1908.

I am, &c.,
ANTON BREINL,
Director, Runcorn Research Laboratories.

The Secretary,
The Incorporated Liverpool School of Tropical Medicine,
Liverpool.

Enclosure 3 in No. 2 in Appendix VI.

B 10, Exchange Buildings, Liverpool, 30 October, 1908.

Department of Economic Entomology and Parasitology.

SIR,

I HAVE the honour to submit the following report on the work of this Department during six months from May 1st to October 31st, 1908.

Students.

The number of medical and veterinary students who attended the course in economic entomology was:—

Summer term, commencing 1 May ...	...	...	...	13
Autumn term, commencing 1 October ...	...	...	...	14
Total ...	...	...	...	27

The number of candidates who entered for examination was six, of whom five passed.

Thirty-six lectures, each followed by a practical demonstration, were given each term, and from 2 to 2½ hours were devoted to each lecture and demonstration irrespective of the time given to the preparation of the material necessary for the practical work.

Investigations.

During the months of June and July a series of experiments were made regarding the methods of controlling the breeding of the common house fly (*Musca domestica*) and a further enquiry regarding the bionomics of this pest was made. A synopsis of the work in connection with this investigation is appended below:—

1. Six fly cages were placed in various parts of the city in order—

- (a) To ascertain the approximate seasonal prevalence, and
- (b) The relative abundance in those areas where intestinal diseases are known to be prevalent, compared with the prevalence of these insects in the healthier districts. A map showing the location of deaths from intestinal diseases in the city is in the course of preparation.

2. A series of experiments were conducted with various compounds in order to ascertain their efficiency, and also to select, if possible, those which are non-poisonous and harmless to both animal and plant life.

3. A temporary fly-proof middenstead was erected in the city, the holding capacity being a little over one ton of manure. This was covered with a framework of wood fitted with two hinged doors, the whole of which was covered with perforated zinc.

4. A non-screened receptacle for manure was used as a control.

Result:—The screened bin proved a most successful means of preventing house flies breeding in the manure, while the manure in the unscreened bin was invariably swarming with house fly larvæ during the period of eight weeks, when the experiments were discontinued.

Papers Published.

1. Some Homopterous Insects collected by Dr. Yngve Sjostedt at Kilimanjaro with 31 figures in the Text. (Herausgegeben von der Konigl. Schwedischen Akademie der Wissenschaften, Upsala, 1908.)

2. A Collection of Homoptera affecting some Cultivated Plants in Java and in West Africa.

3. The Brown Scale of the Gooseberry (*Lecanium ribis*). Journal of the Board of Agriculture and Fisheries, Vol. XV., p. 195, figs. 1-5.

4. A further note on the injurious Coccidæ and Aleurodidæ of Madagascar and Comoro Island.

Papers Completed.

1. Report on the Food of British Birds in relation to Agriculture and Horticulture.

The proofs of this paper have been corrected for the Press, and the paper will be published shortly in the Journal of the Board of Agriculture and Fisheries.

Expedition.

The necessary arrangements have been made for me to sail to Jamaica on the 14th November. The chief objects of the expedition are:—

- (1) To study the bionomics of cattle ticks and advise some methods of control.
- (2) To undertake the investigation of those scale insects which are at the present moment threatening the citrus and cocoa and coco-nut cultivation in the island, and to advise some method of control.
- (3) To make a collection of the biting flies and ticks of the island for the use of students attending the course of instruction at this school, &c.

Arrangements have been made by Professor Major Ross and other members of the staff, so that the lectures on medical entomology shall be given before my departure, and similar arrangements will also be made for the next term to leave a sufficient number of open dates in order that the full course of instruction may be given after my return in February, 1908. By this arrangement the usual number of lectures and practical demonstrations will be given in each of the terms.

I have, &c.,

ROBERT NEWSTEAD.

The Secretary,

The Incorporated Liverpool School of Tropical Medicine,
Liverpool.

APPENDIX VII.

No. 1 in Appendix VII.

CEYLON.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received March 7, 1908.)

The Queen's Cottage, Nuwara Eliya,

MY LORD,

Ceylon, February 18, 1908.

I HAVE the honour to acknowledge the receipt of Your Lordship's circular despatch of 23rd December last,* communicating certain suggestions made by the Advisory Committee of the Tropical Disease Research Fund as to the organisation of laboratories and the directing of research work.

2. I caused the despatch to be referred to the Principal Civil Medical Officer of this Colony, and I enclose a copy of a report on the subject by Sir Allan Perry, with whose views I find myself in agreement.

I have, &c.,

HENRY McCALLUM,

Governor, &c.

* [Cd. 3992], p. 156.

Enclosure in No. 1 in Appendix VII.

Medical Department, Colombo, Ceylon, February 4, 1908.

TROPICAL DISEASES RESEARCH FUND.

SIR,

WITH reference to your letter of the 18th ultimo, I have the honour to report that I am fully in accord with the Advisory Committee of the Tropical Diseases Research Fund on the importance of saving energy, funds, and opportunities by preventing as far as possible the overlapping or unnecessary repetition of research work in the various laboratories in the Colonies; but it should be clearly understood that there is a great difference between such properly equipped experimental research institutes such as exist at Kuala Lumpur and at the King's Institute, Madras, and the Clinical Laboratory such as we have in this Colony.

2. At the large institutes above named the time of the Director is devoted almost entirely to research work, and the six rules mentioned in paragraph 2 of the Secretary of State's despatch might be applicable. But in a clinical laboratory such as the one here, with a Director whose time is taken up with routine work and the duties connected with a clinic for tropical diseases, and who only does research work in his spare moments, I think he should be left with a free hand; he should continue to submit his half-yearly reports and should seek the advice of the Advisory Committee when he feels to need it—I am not in favour of a central authority at home issuing instructions to the Directors of ordinary clinical laboratories, because the routine work would be interfered with and the very small amount of spare time the Directors of such laboratories have for research work would be greatly taken up in writing reports called for by that central authority.

I am, &c.,

A. PERRY,
Principal Civil Medical Officer and
Inspector of Government Hospitals.

The Honourable
The Colonial Secretary,
Colombo.

No. 2 in Appendix VII.

EAST AFRICA PROTECTORATE.

EXTRACT FROM THE BACTERIOLOGIST'S REPORT FOR THE PERIOD
OCTOBER to DECEMBER, 1907.

FURTHER EXPERIMENTS WITH TRYPANOSOMATA AND *Glossina fusca*.

Since the above* was written, work has been continued with the *Glossina fusca*. In all two hundred and fifteen flies have been examined, and in forty-nine trypanosomata were found, giving a percentage of infected flies of about 22.8.

These two hundred and fifteen flies may be further subdivided. Four flies were examined immediately after arrival and were all found to contain trypanosomata of the type *T. Tullochii*. Fifty-seven flies were examined after they had been feeding on an infected dog, and twenty-one of these showed trypanosomata, twenty of the type *T. Tullochii*, and one "cultural" form—a percentage of infected flies of about thirty-seven. One hundred and fifty-four flies were fed on a clean dog, and in twenty-four of these trypanosomata were found, nineteen of the type *T. Tullochii* and five "cultural" forms—a percentage of infected flies of 15.5. Taking all the infected flies forty-three showed trypanosomata of the type *T. Tullochii* and six showed "cultural" forms.

It will be seen from this that the percentage of infected flies was higher among those fed on an infected dog than among those fed on a clean dog. This difference would disappear if flies examined twenty-four hours after feeding were excluded or if one excluded flies showing very few parasites, and only considered those which showed such numbers of parasites as to be evidently the result of multiplication in the gut of the fly, and not simply of ingestion with their food. The number of flies fed on the infected dog is smaller than among the other class, and the probable

* The report of the previous experiments is printed in [Cd. 3992] pp. 152-155.

error is therefore greater. In any case, if feeding flies on an infected dog had anything to do with the presence forty-eight hours afterwards of trypanosomata in the intestine of these flies, certainly a much larger percentage than thirty-seven should have shown the parasite. One would naturally expect every fly to become infected if the trypanosomata of the dog had anything to do with those in the fly.

Further, trypanosomata were found in all four flies examined immediately after arrival, and in 15.5 per cent. of the flies fed on an uninfected dog. The presumption must be that the feeding on the infected dog had nothing to do with the presence of parasites of the "cultural" type and of the type *T. Tullochii* in the flies, but that the latter were probably all infected in some way before they reached the laboratory.

Having arrived at this conclusion, attempts were made to determine whether or no the trypanosomata in these flies were pathogenic. Kibwezi, whence these flies come, has long been a well-known "fly belt." In the days before the railway it was notorious and caused much loss to the Uganda transport. On finding tsetse from this belt with intestines swarming with trypanosomata one naturally at first supposed that these trypanosomata would be pathogenic. But there was an objection to this. All strains of trypanosomata met with so far have been fatal to dogs, yet a trypanosoma, fatal to dogs, did not develop, at any rate constantly, in the *Glossina fusca*, even when that fly was fed on a dog whose blood was swarming with parasites. Of the same batch of flies fed on an infected dog, two days after feeding some would show swarms of trypanosomata in the gut and others none at all. Of the twenty-one flies which showed trypanosomata after feeding on the infected dog, only one showed "cultural" forms, whereas, were the development in the fly simply a culture of the parasites from the dog, one would expect to find nothing but cultural forms.

Inoculation of dog with trypanosomata of Glossina fusca.

As it seemed that the parasites in the fly could have nothing to do with, at any rate, this particular strain in the dog, an attempt was made to prove it. Flies were fed for a few days on a clean dog and then examined. When a fly was found with quantities of parasites in the gut, the intestinal contents diluted with normal saline were injected subcutaneously into a dog. Two experiments were carried out: (1) with the trypanosomata of the type *T. Tullochii*; and (2) with trypanosomata of the "cultural" type. In neither case did infection of the dog follow. It may be said that these experiments are too few, but so far as they go they are fair tests, for large numbers of parasites were injected, and the accompanying bacteria had no ill effect on the dog. It is possible that the dog is not the appropriate host for either of these trypanosomata, but if this is the case it follows that these trypanosomata can have nothing to do with the "fly disease" of the Kibwezi district.

Inoculation of dog with intestinal contents of Glossina fusca fed on an infected dog.

The next experiment carried out was with a view to seeing whether the intestinal contents of a fly that had fed on the infected dog were infectious to another dog, and, if so, for how long.

1. A fly which had fed for some days on a clean dog was fed on an infected dog, and after eighteen hours was dissected and the intestinal contents in normal saline were injected subcutaneously into a clean dog. These contents showed trypanosomata of the most various shapes and sizes, but no "cultural" forms. The dog showed parasites in its blood on the seventh day, and died on the twenty-fifth day. During the course of the disease the parasites in the blood bore a morphological resemblance to *T. dimorphum*, as did those in the original infected dog.

2 and 3. Two experiments were carried out as above but with twenty-four hours' interval between feeding and injection of intestinal contents. The dogs died on the sixth and seventh days, and showed no trypanosomata nor, post-mortem, any cause of death. The experiments were, therefore, inconclusive.

Interrupted feeding experiment with Glossina fusca.

A further experiment was now made to show that the *Glossina fusca* could convey this trypanosoma from infected to healthy dog. Having found in previously reported experiments with *Glossina fusca* and *T. gambiense* that, whereas an interval of even eight hours between the feedings prevented infection from being

conveyed, infection was conveyed when there was practically no interval, two flies which had fed on a clean dog were allowed to half fill themselves on the infected dog and then to finish their feed on the clean experimental dog. Trypanosomata were found in the blood of the latter on the tenth day and the animal died on the eleventh day, showing post-mortem an enlarged spleen. The flies used in this experiment were dissected forty-eight hours after feeding, and found to contain trypanosomata of the type *T. Tullochii*.

One may consider as controls to this experiment two dogs used to feed the flies when they arrived and afterwards if one wished to keep flies alive. Dog No. 104 had one hundred and fifty-six flies fed on it during a period of sixty days. No trypanosomata could ever be found in its blood, and when the animal died no cause of death could be discovered. During life the temperature gave no indication of a trypanosomiasis, nor were there any signs of such an infection post-mortem. Dog No. 99 had sixty-two flies fed on it during a period of forty-six days, and its history was similar to that of No. 104, except that post-mortem the intestine was found to be full of tape worms.

Origin of trypanosomata in Glossina fusca.

The question of the origin of these flagellates in the tsetse fly is still as undetermined as in the case of the flagellates of the mosquito. Koch's supposition that the *T. Grayi* is in relation to the trypanosoma present in crocodiles will certainly not hold for flies coming from Kibwezi, where there are no crocodiles. In no fly has there been seen any trace of any but mammalian blood. Recently Stuhlmann, working in German East Africa with *Glossina fusca*, has described what he considers a development of animal trypanosomata in recently-hatched flies which were given their first feed on an infected animal. Unfortunately I have not got Stuhlmann's original paper, but depend on a précis by Mesnil. From this it would appear that Stuhlmann examined freshly-hatched flies and found no flagellates. From this he concluded that there was no hereditary infection of the fly. Among freshly-hatched flies that had fed on an infected animal he found that 80-90 per cent. showed flagellates, and from this he concluded that those flagellates were derived from the trypanosomata taken up from the infected animal. But if this were the case every fly should have become infected, and there remains unexplained the 10-20 per cent. of flies which showed no infection. In Mesnil's review there is no mention of control experiments carried out by feeding the freshly-hatched flies on a clean animal. If such controls were not carried out, in the presence of this 10-20 per cent. of infected flies one is inclined to think that the infection may have existed in these flies either in some unrecognised form of the flagellate or in very small amount. The few flies examined on arrival at this laboratory showed very scanty trypanosomata, so scanty that it was only by prolonged search that they were discovered.

Novy, MacNeal, and Torrey, in their recent paper on "Trypanosomes of Mosquitoes," argue that, since the trypanosomata in culture tubes are identical with those in the gut of the mosquito, therefore the latter are really "cultural" forms. In the case of the *Glossina fusca* one is at once met by the difficulty that the commonest forms found are not "cultural" forms, but have the centrosome always posterior to the nucleus. Of the forty-five infected flies examined only six showed "cultural" forms, the remaining thirty-nine showing trypanosomata of the type *T. Tullochii*. Yet these latter had evidently multiplied in the gut for they were usually present in such numbers as to preclude all possibility of their having been taken up by the fly from some outside source.

It will be necessary to get cultures of the fly trypanosomata to settle this question, but unfortunately so far cultures have always failed owing to overgrowth of the accompanying bacteria. Further attempts will have to be made by one of the methods recommended by Novy.

Morphologically Novy's description of the *T. culicis* would apply to the "cultural" forms of the *Glossina fusca* except so far as concerns the flagellum. There is usually considerable difficulty experienced in staining the flagellum and diplosome, and when the flagellum can be made out it can only be seen extending 1-2 μ beyond the protoplasm. The diplosome is rarely seen, probably from this difficulty in staining. In specimens showing these cultural forms ærotropism is not seen as described by Novy in the *T. culicis*; the flagellates may be seen in



PLASMODIUM OF GUINEA FOWL.



$11\mu \times 4\mu$ (Parasite)

LEUCOCYTOZOA OF SPUR FOWL.



$15\mu \times 10\mu$



$16\mu \times 12\mu$

PLASMODIUM OF PIGEON.

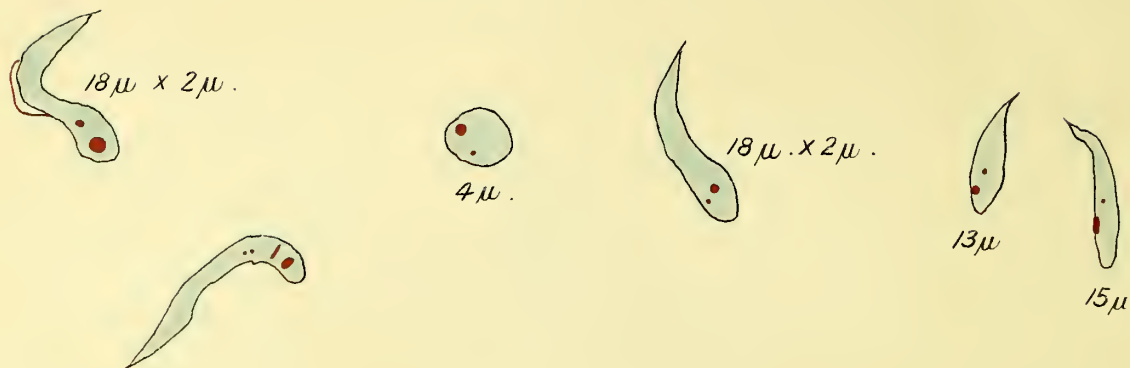


$11\mu \times 4\mu$
(Parasite)



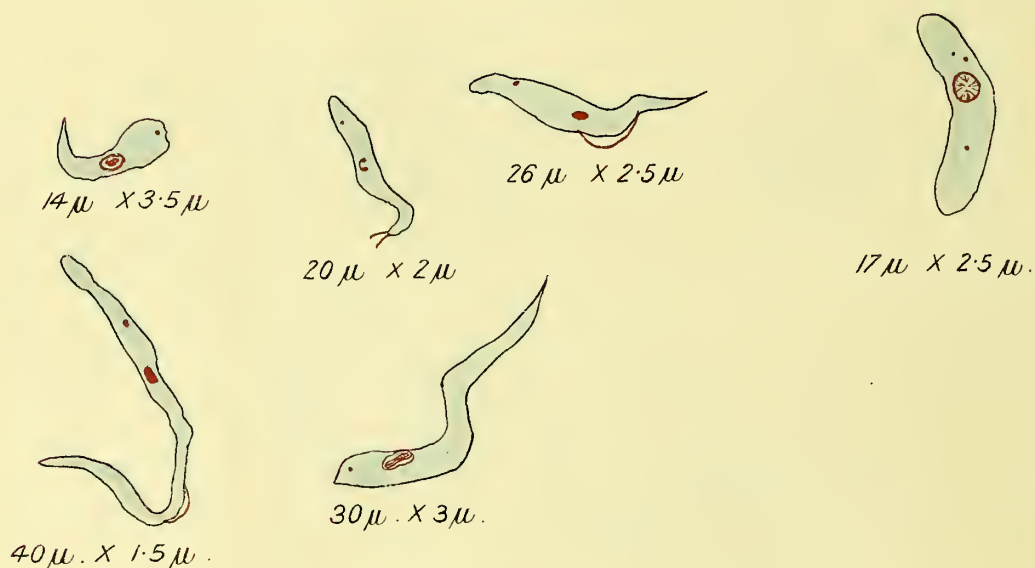
TRYPANOSOMATA OF GL. FUSCA.

(CULTURAL FORMS)



TRYPANOSOMATA OF GL. FUSCA.

COMMONER FORMS, TYPE T. TULLOCHII.



TRYPANOSOMATA OF BYCANISTES CRISTALUS



enormous numbers attached by their flagella to the gut wall, and some of them from time to time move away and swim free, but these free forms do not collect round air bubbles. Rosettes are often seen containing sometimes innumerable flagellates, all with their anterior end pointing to the centre of the rosette. The nucleus is round or oval, and the centrosome is either a small dot or is rod shaped, and is situated anterior to, beside, or beside and just behind, the nucleus.

In some of the specimens there is seen an evident portion of an undulating membrane. The circular forms do not as a rule show a flagellum, but this may be due to bad staining, as flagella have in a few cases been seen extending from the centrosome and circling round the parasite with the last 2-3 μ projecting away from the parasite.

The trypanosomata of the type *T. Tullochii* are more various in size and shape than are the cultural forms.

They vary in size between short, stumpy forms 14 μ long, and long, thin, ribbon-like forms 40 μ long.

Some of the intermediate forms closely resemble the blood forms as seen in dogs and other animals. The nucleus is round or oval, and the centrosome is round and always situated posterior to the nucleus, though never at the extreme end of the flagellate. There is hardly any free flagellum to be seen beyond the protoplasm. The undulating membrane can usually be made out. Since the accompanying drawings were made a modification of Romanowsky's stain has been found, which, while it does not show the internal structure of the flagellate so well as does the Leishman, nevertheless much more constantly stains the membrane and flagellum. From specimens stained by this method it would appear that membrane and flagellum are constantly present, but that the flagellum is exceedingly short. In trypanosomata of this type, none are ever seen attached to the gut wall, ærotropism is never seen, and rosettes are exceedingly scarce.

Conclusions.

Any conclusions arrived at depending on the results of the above experiments must be considered as provisional until these experiments are repeated, but results so far make the following conclusions probable:—

1. Two forms of trypanosomata are met with in *Glossina fusca* in about 15 per cent. of the flies examined.
2. Intestinal contents of flies showing either of these forms are not pathogenic to dog.
3. Intestinal contents of a fly fed eighteen hours before on a dog infected with trypanosomata are pathogenic when inoculated into another dog.
4. There is no development of these trypanosomata from the dog in flies fed on an infected dog.
5. The *Glossina fusca* can convey this trypanosoma of the dog from infected to clean dog by interrupted feeding.

Trypanosoma of Bycanistes cristatus.

In a previous report I described a trypanosoma found in the *Bycanistes cristatus*. Drawings of this parasite are now given. The trypanosoma appears to be exceedingly thick, as in many specimens the nucleus is almost invisible owing to the thick layer of overlying blue-stained protoplasm.

Two attempts were made by my laboratory assistant, L. S. S. Pillay, to infect fowls with blood rich in these trypanosomata, but in neither case did infection follow inoculation.

Plasmodia of Pigeon and Guinea Fowl.

The finding of plasmodia in pigeon and guinea-fowl has been described in a previous report. Drawings of both these parasites are now given.

Leucocytozoon of Spur Fowl.

In the blood of a spur fowl shot near Nairobi, parasites were found in the large mononuclear leucocytes. These parasites stained a uniform pale blue, and showed chromatin in small dots, which were either collected into groups or scattered more or less irregularly. The parasite filled the greater part of the leucocyte, sometimes

filling the whole leucocyte. The nucleus was either pushed to one side of the leucocyte or was bent round the edge of the parasite.

Filaria in gut of Glossina fusca.

In sixteen of the two hundred and fifteen flies examined, or about 7.5 per cent., microfilariæ were found in the intestinal contents. These filariæ were always of one kind. Their average length was 240μ they had sharp caudal extremities and no sheath could be made out. They appeared to remain in the gut of the fly, for no sign of their passage into the body cavity was ever seen. At no matter what period after arrival the flies were examined no difference could ever be seen in the filariæ. The possibility of their having been taken in with the blood of the dogs on which the flies were fed can be excluded, for filariæ have never been found during the frequent examinations of the blood of these dogs nor post-mortem in the bodies of such of the dogs as have died.

PHILIP H. ROSS.

March 6, 1908.

No. 3 in Appendix VII.

FEDERATED MALAY STATES.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 23 May, 1908.)

MY LORD,

Government House, Singapore, 29 April, 1908.

WITH reference to my despatch dated the 13th November, 1907,* I have the honour to forward herewith, a report on the work done in the Institute of Medical Research at Kuala Lumpur during the six months October, 1907, to March, 1908.

I have, &c.,

JOHN ANDERSON.

Enclosure in No. 3 in Appendix VII.

SIX-MONTHLY REPORT of the Institute for Medical Research, Kuala Lumpur, Federated Malay States, from October, 1907, to March, 1908.

The experimental inquiry concerning the etiology of beri-beri has been continued during the past six months and is still in progress.

As was stated in the last report a number of cases of the disease had occurred in the group of coolies feeding on Siamese rice and no cases had occurred among those feeding on Indian rice.

On October 19th the conditions were reversed, the groups hitherto using Siamese rice being given Indian rice and *vice versa*. No changes, other than the alteration of this factor in the diet were made, the coolies continued to occupy the same quarters as before, and other dietary factors remained the same. Since this change no further cases of the disease have developed.

Owing to the requirements of the work on which the coolies are engaged, the group now feeding on Siamese rice were on March 22nd transferred from Kuala Ayer Baning to quarters newly erected at the sixty-fourth mile (Sungei S'Menting). The greatest care has been taken to keep this group free from all possible sources of infection. As yet there have been no signs of beri-beri among them.

The chemical investigation of the samples of the rice issued daily is proceeding; so far no definite results have been obtained.

The work on surra was terminated at the close of the year and a report of the results obtained is now in the Press.

An investigation of chandu and the products of chandu-smoking was carried out for the Opium Commission and a report has been furnished.

The Bacteriologist has been engaged in routine work.

The Chemist has given me much assistance in the work on rice; in addition he has conducted a large number of analyses of milks, waters, foodstuffs, and drugs; he has also carried out several medico-legal investigations.

* [Cd. 3992], p. 100.

The Entomologist is still pursuing his studies on the biting flies; he has also devoted a considerable part of his time to a study of the life history and habits of white ants. A paper by him on this subject will be published in the "Agricultural Bulletin" at an early date.

H. FRASER,
Director of the Institute for Medical Research,
Federated Malay States.

No. 4 in Appendix VII.

FIJI.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 21 April, 1908.)

MY LORD, Government House, Suva, Fiji, 9 March, 1908.

I HAVE the honour to acknowledge the receipt of your Circular despatch of 23rd December last* on the subject of research work done in the Colonies and the advantage to be derived from a proper direction of that work, and to enclose, for your information, a copy of a minute by Dr. Lynch, Acting Chief Medical Officer, as to the investigations carried on in Fiji.

2. The matter under consideration is one which has often been in my mind since I came to Fiji and I have on more than one occasion spoken of it to Dr. Corney, Chief Medical Officer, but I see no way of facilitating research work here except by the appointment of a special medical officer for the purpose. The expense of such an appointment under present circumstances would not, it seems obvious, be justified.

I have, &c.,
EVERARD IM THURN.

Enclosure in No 4 in Appendix VII.

MINUTE.

HONOURABLE COLONIAL SECRETARY,

I DO not know that any original investigations are at present being carried out in the Colony. Anything that is done is more of the nature of private and perhaps only preliminary inquiry by individuals. So far as I can see, the work contemplated in the circular is that of the direction of a laboratory, to which the officer in charge must give his whole time. From my own experience, I have found it quite impossible to do any satisfactory bacteriological work unless I give up the whole of my time to it. It has been tried in Suva, where we had at one time a small fitted laboratory, but I confess with regret that my official and other work left me but few half hours in which to make use of it.

The facilities are already there for investigation—it is only the man with time at his disposal who is lacking.

G. W. A. LYNCH.

27 February, 1908.

No. 5 in Appendix VII.

GOLD COAST.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 7 March, 1908.)

MY LORD, Government House, Accra, 18 February, 1908.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of the 23rd of December,* relative to the organization of laboratories and the direction of research work in the Colonies, and to report that in the Gold Coast Colony there is at present no institution to which the term laboratory can properly be applied.

* [Cd. 3992], p. 156.

2. In your Lordship's despatch of the 27th of April, 1907,* a scheme was formulated for the establishment at Lagos of a medical research institute for all the West African Colonies. Sir John Rodger, in his despatch of the 31st of May,* expressed his full concurrence in this proposal; and provision has been made in the current estimates for an annual contribution of £400, in addition to £500 as this Colony's share in the cost of erecting the necessary building, and quarters for the European staff of the Institution.

Under these circumstances certain proposals which had been made previously for the establishment of a suitable laboratory at Accra were not carried into effect; but the Principal Medical Officer is making efforts to equip a room in one of the hospital buildings in which to conduct a measure of research work and investigation.

3. I propose to take advantage of Professor Simpson's visit to Accra in connection with the outbreak of plague, to ask him to advise the Principal Medical Officer as to the necessary equipment for the proposed local laboratory, which, in order to prevent overlapping of work, should keep in touch with the Central Institute to be established at Lagos.

I have, &c.,
H. BRYAN,
Acting Governor.

No. 6 in Appendix VII.

HONG KONG.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 7 March, 1908.)

MY LORD,

Government House, Hong Kong, 7 February, 1908.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of the 23rd of December last,† and to inform you that the rules suggested therein for the direction of research work in Colonial laboratories will be adopted in the Bacteriological Institute in this Colony.

I have, &c.,
F. D. LUGARD,
Governor, &c.

No. 7 in Appendix VII.

HONG KONG.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 24 April, 1908.)

MY LORD,

Government House, Hong Kong, 24 March, 1908.

I HAVE the honour to forward a report by Dr. C. M. Heanley, Acting Bacteriologist, on research work completed, in progress, and in contemplation at the Bacteriological Institute in this Colony for the four months October to January inclusive.

I have, &c.,
F. D. LUGARD,
Governor, &c.

Enclosure in No. 7 in Appendix VII.

SIR,

Bacteriological Institute, Hong Kong, 16 March, 1908.

I HAVE the honour to forward my report of research work "completed, in progress, and in contemplation," at the Bacteriological Institute, for transmission to the Secretary of State for the Colonies, in accordance with General despatch of 6 December, 1906, and Circular despatch of 23 December, 1907. The report covers four months only.

I have, &c.,
C. M. HEANLEY.

The Honourable
The Principal Civil Medical Officer.

* Not printed.

† [Cd. 3992], p. 156.

REPORT of the Research Work Completed, in Progress, and in Contemplation at the Bacteriological Institute and Public Mortuary, Hong Kong, October, 1907, to February, 1908.

Staff.

This consists of the Acting Bacteriologist, C. M. Heanley.

General Remarks.

There are two factors working towards making this report smaller than usual. Firstly, the Bacteriologist is on leave, and the routine work of the Mortuary and Institute is about as much as one man can do. Secondly, the alteration in the date for sending the report causes it to cover four months instead of six.

A large Fluke of Man probably not hitherto described. Fasciolopsis Buski as a Parasite of Man in Hong Kong, its usual Host probably the Pig.

Some time ago Doctor Kwan King Hung brought me a large fluke in hopes that I should be able to identify it, and advise him as to the treatment of the case in which it had occurred. The case was that of a young girl aged about eight years, who lived in a small village on the Island of Hong Kong. The history was that the child had had several attacks of vomiting, which had resulted in the expulsion of one or more flat worms. I told Dr. Kwan that the worm might be *Fasciolopsis Buski*, but that I thought it was an undescribed species. He wished me to do what I liked with it, and volunteered to try and get some more.

Unfortunately the child was taken away to Canton by the parents, and the subsequent history obtained was that she vomited many more of the flat worms, and had died vomiting. The child had lumps in the lower part of the neck, and Dr. Kwan considered that she was tubercular.

The worm was brought to me in weak spirit; it then measured exactly two inches long, and just over half an inch in breadth. It consisted of a large posterior oval part, which was rather narrower in front than behind, and of a small anterior part loosely attached to the posterior by a distinct joint. This anterior part measured just over one-eighth of an inch long and a little more than one-sixteenth of an inch broad. Its shape was that of an oval, with one end flattened to form the joint mentioned; its shape and appearance were quite distinct from those of the cone of *Fasciola hepatica* or the cone seen on *Fasciolopsis Buski* in certain states of contraction. On one surface of this segment was a depression bounded in front by an overhanging lip which projected backwards. On the anterior half of the posterior segment of the worm there were five round pits, due apparently to gastric digestion, but nothing in any way resembling the large posterior sucker of *Fasciolopsis Buski* could be seen. On staining the worm with carmine and mounting in balsam it showed the following points:—The yoke glands were extensively developed, meeting each other behind. The testicles were large, placed one behind the other, and branched repeatedly. The ovary was branched. All the above structures, and also the shell gland showed a close resemblance to those of *Fasciolopsis Buski* in size, shape, and arrangement. The genital pore opened immediately behind the joint which separated the anterior from the posterior segment, and close beside it was the opening of a long sac, cirrus pouch, situated in the middle line. The deep posterior sucker of *Fasciolopsis Buski*, into which the cirrus pouch of that worm opens, was absent. I could not describe the intestine with certainty for it was indistinct, but the cæca were unbranched, and had two sharp curves, one in front of and the other behind the anterior testicle. The cæca, I think, either opened separately at the anterior corners of the posterior segment or they turned directly inward at those points. The anterior segment showed a finely-striated boarder suggesting that it was an organ of attachment. The worm had spines. *Fasciolopsis Buski* is variously described as being with and without spines. I find that it has spines, but that they are not easily seen in some mounted specimens.

Vigorous search has been made at the Public Mortuary for more specimens of the worm, but they have not so far been found. However, I have found a single case of infection with *Fasciolopsis Buski*, three of the parasites being present in the jejunum of a child aged ten. I was at once struck with their naked eye resemblance to a very common fluke which is found in the stomach and in the small and large intestines of South China pigs. In cleared specimens the very slight differences were, I considered, accounted for by differences in development of the individual specimens and chiefly concerned the amount of curvature of the cæca. Some time

ago Dr. Bell sent some of the distomes, so common here in pigs, to the Liverpool School of Tropical Medicine, and he tells me that Dr. Looss, of Cairo, who examined them, is before me in the discovery that they are *Fasciolopsis Buski*, and he showed me Dr. Looss's article in the Annals of Tropical Medicine and Parasitology. I am anxious to acknowledge the priority, but Dr. Looss does not mention that the parasites he described as *Fasciolopsis Buski* came from pigs, though I have no doubt that they did so, and were sent by Dr. Bell. It will be news to helminthologists that *Fasciolopsis Buski* is the same as a common parasite of pigs, but the Colonial Veterinary Surgeon, Mr. Gibson, has for some time suspected (Colonial Veterinary Surgeon's Report, 1905) that this is so, though he has had no specimens but only book descriptions of the human parasite with which to compare those found in pigs.

Fasciolopsis Buski would appear from books to be a very rare parasite. Max Braun's book, published in 1906, says that the worm has only been observed in the intestine of man and that seven cases represent the literature. However, I have met two doctors who have had cases and I suspect that its rarity at the Hong Kong Mortuary may be due to the fact that pigs are not kept in the town. Most Chinese villages, however, swarm with pigs.

Opisthorchis Sinensis.

An article on 109 cases of *Opisthorchis sinensis* infection of man was written in December for the Journal of Tropical Medicine and accepted. It is rather beyond the scope of this report because it deals with observation mostly extending over a different period.

I should be glad to obtain from the Tropical Diseases Research Fund Committee a list of invertebrate animals that it would be worth while experimenting on as intermediate hosts for the worm.

The study of fluke diseases in Hong Kong is somewhat important; there are few domestic animals which do not harbour these parasites. The Colonial Veterinary Surgeon, Mr. Gibson, has from time to time brought to notice the numbers and varieties found at the slaughter house. About five sixths of the area of the Colony is unoccupied land, mountains and hill sides, covered to a large extent with coarse grass. A feature of the hills is the absence of animal life. The sheep of Europe or the herds of goats which in India crop most jungle lands so close are absent. It is chiefly a question of parasites. Animal parasitology in South China is a large, difficult, and little-explored field.

Trypanosomiasis, Spirillosis, Glanders.

During the absence of the Colonial Veterinary Surgeon on leave I have had many blood slides to examine from cattle suspected of having anthrax. A large trypanosome was noticed in the blood of several of the cattle. It was morphologically similar to *T. theileri*, being often over 60μ long, and having a long flagellum and acutely pointed posterior extremity. It was present in very small numbers. I have not seen or heard of "bile sickness" in the Colony.

In addition to the above slides I have examined the blood of all calves sent to me for vaccination, but I have never again found the spirillosis of cattle which I described some time ago.

Two cases of disease in horses from the same stable were examined; one was a case of nasal discharge, the other of chronic abscesses. Material from both animals gave Strauss's reaction in guinea pigs, and from one of these a non-gram staining, non-motile bacillus giving a sticky yellow growth on potato was isolated. The investigation is not finished. I had no mallein.

Diseases of Rats.

It has long been known that some diseases of man are contracted from animals; moreover, animals often suffer from diseases which, though not the same, are closely allied to human diseases and study of the one has thrown much light on the other. It is, no doubt, through the channel of comparative pathology that our knowledge of much that is obscure in human disease will advance. In October last I commenced a research into various diseases attacking rats in Hong Kong. I hoped that it might throw some light on the contagion of leprosy, tuberculosis, cancer, or some other human disease, the rodents being so closely associated with man. No results of much value have so far been obtained.

It had been the custom previously to October, 1907, to examine all rats caught or found by the rat catchers for plague by stained smears of the heart blood and

spleen made by a coolie trained to open the rats and prepare the smears. However, the present Indian Plague Commission recently published full accounts of a better method, consisting chiefly of opening up the sites of all the lymphatic glands to naked eye inspection. In October this more advanced method was substituted here, and it gave me abundant opportunity of studying the lesions of various rat diseases.

Leprosy.—It is not infrequent to find on older rats patches of skin which appear dry and scaly and a little thickened, and from which the hair has fallen off. These are not unlike the skin lesions of anæsthetic leprosy of man in appearance. I have not found the leprosy bacillus in rats suffering from them, though further search will be made in the nerves. The condition described is not the same as the well-known disease of rats associated with acid fast bacilli.

Tuberculosis.—I have not found this disease in rats in Hong Kong. Rats have frequently been found with the whole of one lung or a single lobe completely replaced by a caseous mass. Caseous lumps and small abscesses with thickened walls have been found in the mesentery and cold (chronic) abscesses with thickened walls have been found elsewhere. These lesions to the naked eye looked tubercular, but the tubercle bacillus was not found by staining, and inoculated guinea pigs have so far remained healthy (one died of plague). In most of the lesions the caseating process has been too advanced to allow of obtaining sections, but one which has been examined did not show tubercles; moreover, generalised tuberculosis has not been found. A proportion of the caseous lumps and chronic abscesses were, no doubt, due to degenerated parasitic cysts. Livers of rats are sometimes found containing hundreds of these cysts, the true substance of the liver being almost absent, and all stages of the degenerative process are found in the liver from cysts containing dead worms to encapsuled abscesses. The sequence is not, however, clear in other organs.

It may be said that tuberculosis is very common amongst the Chinese, and that tuberculosis of native Chinese cattle is exceedingly rare. Rats are recognised to be highly resistant to experimental inoculation with tuberculosis.

Cancer.—The following are examples of neoplasms:—

1. An old male decumanus rat showed flattened white spots up to 2 m.m. in diameter, and very numerous in number on the parietal and visceral layers of the serous membranes of the chest and abdomen. They were almost absent from the anterior abdominal wall, though very numerous on each side of the spine. The right kidney was enlarged to about three times its natural size. When cut its consistency and appearance resembled those of a rapidly growing cancer. Some of the omentum was thickened to quarter of an inch by white nodules massed together. The lobes of the liver were partially covered with nodules, which caused them to adhere together. The seminal vesicles and epididymes were covered with similar nodules. The testicle was normal. Sections of the kidney showed that the proper substance was largely replaced by well formed cells of another type. The thickened mesentery showed the same cells.

2. An old male decumanus rat showed a nodular growth about the size of a hen's egg, springing apparently from a lobe of the liver; it had the naked eye appearance of a cancer. Microscopically it was composed of cells forming the walls of spaces. I considered it to be probably a mixed-celled sarcoma.

Rats are sometimes found with great thickening and matting together of the tissues of the foot. The disease is not common, but when seen often affects two or three feet. It appears to ulcerate through the skin in later stages.

I need not now continue the account of investigation into diseases of rats; the work is in progress, many of the inoculated animals are still alive, and the paraffin blocks uncut.

Six Deaths of Infants from Over-distension of the Stomach with dried Persimmons (King Chee). A Contribution to the Study of the Cause of the Excessive Infantile Mortality of the Colony.

From time to time bodies of small children have been seen at the mortuary in which the stomach was distended to bursting point with a material like coarse vegetables. I have made many enquiries as to what the material might be, with the results which are given below. A Committee which sat in Hong Kong in 1903 to enquire into the excessive infantile mortality of the Colony did not mention the

use of king chee, and doctors whom I have spoken to about it either do not know of the custom or they merely know that king chee is given by mothers to children.

The Cantonese infant is breast-fed more generally than at home. When the mother cannot feed the child a wet-nurse is, when possible, procured. The fresh milk of animals is almost never used by the Cantonese as a food for infants though condensed milk is given to some extent by the poor in coast ports. It is not always possible to breast-feed an infant, and the Cantonese resort to at least two other methods of feeding very young children. One method is that of giving what are called "birth cakes"—these are composed of sugar and rice, the latter is more or less cooked by dry heat after washing, and is then very finely powdered. When used the cakes are made into an emulsion with water. The birth cake is used more especially during the first few days of life while waiting for milk to come into the breasts, or while making arrangements for a wet-nurse. Another method is that of giving king chee. When bought at the shops this is found to be whole dried persimmons which are shrunken and are about the consistency of dried figs. They are, I am told, given to the child in small pieces, unsoaked, between drinks of water. On soaking them in water they swell considerably, and can easily be broken up into soft stringy pieces of a yellowish colour. During the thirteen months January, 1907, to February, 1908, there have been examined at the Hong Kong public mortuary three hundred and eighty-three live-born children under the age of one month. And in six of these death was considered to be due to the mechanical effects of overfeeding with king chee.

The cases are as follows:—

Case 1 was a male; judged by the condition of the cord to be about seven days old. The over-distended stomach was tightly packed with masses of king chee, there was no free fluid in the stomach. The king chee was moist, but appeared as though it would take up more moisture.

Case 2 was a male considered to be about six days old. There was a large lump composed of pieces of imperfectly soaked king chee in the abdomen partly covered by shreds of the digested stomach. There was acute peritonitis matting the intestines and the remains of the stomach. The umbilical cord was separating normally, and the umbilical vein was normal in appearance.

Case 3.—A male, aged seven days. The stomach was distended with king chee and ruptured apparently from over distension. It was not possible to say whether the rupture took place before or after death.

Case 4.—A female, about seven days old. The notes are the same as those of case three.

Case 5.—A male, aged five days. The stomach was burst, and some of the king chee was lying in the abdominal cavity; it lay chiefly outside and in front of the ascending and descending colon, and between the small intestines and anterior abdominal wall.

Case 6.—A male, aged about fifteen days. There was acute fibrinous peritonitis over the stomach, liver, and intestines. The stomach was too digested to allow of any antemortem perforation being found; its remains partially covered a large mass composed of pieces of king chee compressed together. The umbilicus had healed. The remains of the umbilical vein contained normal clot.

King chee is not infrequently seen in stomachs of young infants together with free fluid, but in all the cases recorded above, except No. 5, the pieces of king chee were caked together like a cast of the stomach, and in no case was there free fluid in the viscus. It seemed mechanically impossible that the mass could be passed into the intestine or vomited.

Beriberi and Gup Sik.

A large number of cases of beriberi are brought to the mortuary, and scarcely a month goes by without a certain amount of work being done on it. Beriberi as a cause of death amongst adults in this Colony is more important than malaria, and ranks behind plague and tuberculosis only.

Three years ago I expressed the opinion that whatever the parasite of beriberi might be it would turn out to be a protozoan, not a bacterium. I need not go at length into the matter, but a full account of my reasons was published in the Indian Medical Gazette in May, 1905, and Dr. Daniels subsequently expressed a very similar opinion about beriberi in his "Observation in the Federated Malay States on beriberi." I have done my best not only during the last four months, but since

coming to Hong Kong to find a parasite of beriberi by histological examinations. I have used Leishman's and Giemsa's stains for smears of every kind of tissue and fluid of bodies that have died in different stages of beriberi, but without success. I have also searched in the common ecto-parasites of man, *pediculus corporis* and *pediculus capitis*. Of course the parasite may be of ultramicroscopic size. One of the greatest difficulties about the study of beriberi is that it has never with certainty been reproduced in any animal, though some observers have made numerous attempts. I hope during the coming summer to do some experiments on anthropoid apes. I feel that the experiments will be justified for the following reasons:—

- (1) In very recent years such peculiarly human diseases as leprosy, syphilis, yellow fever, &c., which were for long thought not to infect animals have been conveyed to the higher apes.
- (2) Owing to the difficulty of keeping them, at least in temperate and sub-tropical climates, anthropoid apes have been left out of many inoculation experiments on beriberi, for instance, the almost classical experiments of Hunter and Koch.
- (3) A simple inoculation experiment does not necessarily satisfy the specialised parasitism of the protozoa, for example, the recently discovered organism of syphilis may not produce the disease when inoculated into the blood stream of a monkey, but does so without fail if rubbed into the abraded skin.

I have read the book recently written by Braddon and also Fletcher's work on beriberi, and I have prepared the following table, which shows the peculiar age and sex incidence of beriberi at the public mortuary here not only for the last four months but for the twenty months before that. I am well aware of the small fallacy in the table due to errors of diagnosis, and to the fact that many of the diseases causing the deaths other than those due to beriberi have a varying age and sex incidence. I can only state now that the table is highly representative of the general community, and is not vitiated by the inclusion of adult cases of beriberi contracted in any institution.

TABLE Showing Age and Sex Incidence of Beriberi at the Public Mortuary, Hong Kong.

Date.	Deaths of males over 15 from beriberi.	Deaths of females over 15 from beriberi.	Deaths of males under 15 from beriberi.	Deaths of females under 15 from beriberi.	Deaths of males over 15 from all causes.	Deaths of females over 15 from all causes.	Deaths of males under 15 from all causes, excluding children under 1 year.	Deaths of females under 15 from all causes, excluding children under 1 year.
Feb., 1906	3	—	—	—	33	5	19	22
March, "	8	—	—	—	60	17	31	36
April, "	26	—	—	—	90	24	36	53
May, "	21	4	2	—	134	41	64	67
June, "	12	2	—	1	67	23	28	25
July, "	15	—	2	—	50	10	21	23
Aug., "	9	2	2	4	33	12	17	26
Sept., "	7	—	1	1	56	15	30	20
Oct., "	7	—	—	2	49	14	17	23
Nov., "	3	—	—	2	25	6	14	18
Dec., "	2	—	1	—	24	8	18	13
Jan., 1907	4	—	—	1	40	6	22	30
Feb., "	4	—	—	—	29	8	20	85
March, "	5	—	1	—	42	7	31	29
April, "	2	1	—	—	24	6	23	33
May, "	14	2	—	—	41	10	27	28
June, "	2	1	—	—	17	9	24	25
July, "	9	—	—	—	51	4	27	19
Aug., "	6	—	—	—	40	6	29	22
Sept., "	8	—	—	—	34	4	22	17
Oct., "	5	—	—	—	31	1	17	20
Nov., "	2	1	—	1	17	5	16	12
Dec., "	8	—	2	—	23	3	10	20
Jan., 1908	8	—	—	—	20	6	32	43
Total ...	184	13	11	12	1,030	250	595	769

The table shows, roughly, that one adult male has died of beriberi out of every six examined, and one adult female out of every nineteen. Of persons between the twelfth month and the end of the fifteenth year, one out of every fifty-six has died of beriberi. It is difficult to make this age and sex incidence fit in with any rice theory which shall account for anything like a major proportion of cases of beriberi occurring in Hong Kong.

The special incidence of beriberi on adult males in Hong Kong is more like that of such diseases as syphilis or gonorrhœa than that of a disease affecting the food supply. There is a disease which to the Chinese mind is a special entity, I mean gup sik; it is said to be caught during sexual intercourse, to appear after a varying incubation period, to run a short course and high mortality, and be chiefly characterised by thoracic embarrassment and by cyanosis of the hands and face at death. When sent to the mortuary it is found to be beriberi, and sometimes pneumonia or pleurisy.

The nomenclature of disease has often passed from a homogeneous to a heterogeneous state with increase of knowledge; we have but to look from abdominal typhus to the divisions of the paratyphoids. Already there are very good reasons to suppose that some epidemics of ship beriberi, particularly those of Norwegian sailing ships, are a different disease than tropical beriberi. We have not yet sufficient evidence to enable us to split up tropical beriberi into a grain intoxication and a contagious disease, but I submit that many cases of beriberi occurring in Hong Kong are probably the latter; that the age and sex incidence of the disease is against any theory of grain intoxication; and that the possibility of a venereal origin of a proportion of the cases should not be lost sight of. Contagion by an insect intermediary and contagion by close contact (too close to allow of contagion in hospital) would be near of kin in the evolution of a germ's contagious faculty.

Work in Contemplation. An Opsonic Treatment for Leprosy.

A few months ago I sketched out a plan of some work which I intended to do in this direction, but it has been found at present impossible to get on with it because opsonic work is incompatible with the frequent interruptions necessitated by the routine work which is done. However, I hope to be able to go ahead with the matter in the autumn, and should be glad of any criticism or advice from the Tropical Diseases Research Fund Committee.

It is well known that the tubercle and leprosy bacillus are in many ways closely allied. Moreover, lepers give the tuberculin reaction. It is, therefore, reasonable to suppose that if tuberculin was administered to the leper under the control of the opsonic index, it would produce curative results.

Moreover, leprosy nodules contain such a great mass of bacilli that they could probably be used after appropriate treatment in place of the tubercle culture not only in the opsonic test, but in the preparation of a vaccine. Thus, the investigation would fall under two heads:—

- (1) The opsonic treatment of the leper with tuberculin.
- (2) The opsonic treatment of the leper with a substance analogous to tuberculin prepared from leper nodules.

Pieces of skin crowded with nodules were taken from a leper who had just died from a self-administered dose of opium. Juice squeezed from the nodules was extremely rich in leprosy bacilli, which crowded the cells in large masses. Several pieces of skin were placed in test tubes, and covered with four times their bulk of 50 per cent. glycerine in distilled water. They were then heated to 70° C. for two hours on each of three successive days, and were subsequently ground in an agate pestle and mortar and heated to 100° C. for twenty minutes in the 50 per cent. glycerine. I propose to experiment with the resulting product on healthy and tubercular animals both before and after filtering through porcelaine and after the addition of caustic soda, the products being somewhat analogous to the old tuberculin and tuberculin A. The preparation of a product analogous to tuberculin R. will present the same difficulties as are met with in preparing tuberculin R.

C. M. HEANLEY,
Bacteriologist.

No. 8 in Appendix VII.

HONG KONG.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 12 November, 1908.)

MY LORD,

Government House, Hong Kong, 10 October, 1908.

IN continuation of my despatch of the 24th of last March,* I have the honour to transmit the enclosed report of the Government Bacteriologist for the six-monthly period ending on the 1st of last August. The report has, I regret, been delayed owing to the illness of Dr. Heanley.

I am, &c.,

F. D. LUGARD,

Governor, &c.

Enclosure in No. 8 in Appendix VII.

SIR,

14 August.

I HAVE the honour to forward my report of research work for the six-monthly period ending August 1st, 1908.

I have, &c.,

C. M. HEANLEY.

The Honourable

The Principal Civil Medical Officer.

REPORT of Research Work for the six months, February 1st to August 1st, 1908,
from the Bacteriological Institute, Hong Kong.

General Remarks.

There is very little to report for the period under review. The Bacteriologist continues to be on long leave. I was on sick leave in May, and it has taken most of the remaining time to do the arrears of routine work which had accumulated. There are, however, a few points about which something may be said.

The Chloroform Process of Maturing Calf Lymph.

In the early spring there was a sudden and unprecedented demand for lymph, and I was obliged to resort to the chloroform process or lose several hundred dollars by refusing orders. I have found it so successful that I think a few words may be said about it. A person doing the process may follow Green's description in the "Lancet" of June 20th, 1903, until the place where he says "The chloroform is evaporated till no trace remains, such evaporation is most quickly effected by passing a stream of sterile air through the emulsion." It will be noticed that no indication of the time necessary is given and no test for the end point. These details may be published elsewhere. I use the following method and test: When the passage of chloroform vapour has been stopped, I cause the sterile air to bubble through not merely briskly but furiously for six hours; I then test a little of the vaccine by heating with a few drops of aniline and caustic potash solution in a test-tube. If there is any difference between the smell of the tube and the control without vaccine I go on passing air until the difference disappears. I glycerinate the vaccine just after doing the first test.

Dr. Neild Cook, "Indian Medical Gazette," May, 1907, says of his chloroformed vaccine: "I found it less reliable than glycerinated and other experimenters have arrived at the same conclusion." I must say that though my experience of it is small, I think that when great care is taken to get rid of the last traces of chloroform then the chloroformed vaccine will be as good as or better than the glycerinated.

The Preservation of Vaccine Lymph in the Tropics.

I have recently got out a Hearson's cool biological incubator. I mature glycerinated vaccine at a fixed low temperature in the incubating chamber and afterwards keep it at about the freezing point in the ice box of the incubator. It substitutes precision for the irregularity of an ice chest. Some vaccine, which was partly matured when the apparatus arrived, was stored in this way, and has kept well for nearly four months and will probably keep much longer. Dr. Neild Cook has succeeded in keeping vaccine from one winter to the next in India by the judicious

* No. 7 in Appendix VII.

use of a cold storage plant, and I believe it will not be necessary in the future to prepare vaccine in the summer in Hong Kong. I have been considering the use of the thermos flask and its principle for keeping lymph cold when sent to the users.

In order to understand the principles which underlie the proper storage of vaccine lymph in the tropics and to see in what direction we may be able to make further advance, I think we should apply to the matter the generalisation of Herbert Spencer that in any aggregate incident forces work secondary redistributions easily when the contained motion is large in quantity and work them with increasing difficulty as the contained motion ceases, remembering, however, that we are dealing with a living organism. Vaccine lymph is now preserved by checking its molecular motions by cooling to zero or lower and by increasing its viscosity with lanoline. Cold storage is often not available in the tropics, especially during transit. Is lanoline the last thing as an excipient? I am trying others. I use the rabbit to test and reinforce vaccine.

Ratin No. 2.

I was asked early in the year to do some experiments on rats with the above material. I found that wild house rats, *mus decumanus* and *mus rattus*, ate it greedily and that it was very fatal to them. A group of seven that I especially observed died within three days, most of them died within twenty-four hours. When seen about eighteen hours after eating the ratin some were dead, the others could be handled easily. Two progressed along the ground by rolling over and over sideways, being apparently paralysed on one side only. The amount of ratin given to these rats would have provided a piece about the size of a filbert for each. I was not able to set up a fatal epidemic amongst rats by feeding them on others that had died of ratin poisoning.

On staining microscopical preparations of ratin No. 2, a coccoid organism, often occurring in pairs, is seen in considerable numbers; it is quite different from the bacillus of ratin No. 1. When ratin No. 2 is sown on agar a streptococcus-like growth appears generally in pure culture and apparently due to the same organism that is seen on microscopical examination. I have grown this organism on rat blood agar, in a broth prepared from minced rats, in glucose rat broth, and in glucose agar stabs, but I have not succeeded in poisoning rats with any cultures. I was about to try to reinforce the cultures by intraperitoneal passage when I had to stop the work through illness.

The great bulk of a tin of ratin appears to be bread, but there is present a considerable quantity of a substance which reduces Fehling's solution.

Mr. Terry, a naturalist trained at the British Museum, and employed by the Hawaiian Sugar Planters' Association, is doing some experimental work at the Bacteriological Institute in collaboration with F. Muir in the East Indies, the object being to transfer some parasitic insects from there to Hawaii for the destruction of a beetle pest.

C. M. HEANLEY.

No. 9 in Appendix VII.

JAMAICA.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 12 February, 1908.)

MY LORD,

King's House, Jamaica, 28 January, 1908.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of the 23rd ultimo,* conveying suggestions from the Advisory Committee of the Tropical Diseases Research Fund as to the organization and working of laboratories and research institutes in the Colonies, which you recommend for adoption in this Colony.

2. In reply I have the honour to state that these suggestions will be of valuable guidance in the ordering of the work of the Government Laboratory which it is proposed to establish in connection with the public hospital at Kingston.

I have, &c.,

SYDNEY OLIVIER,

Governor.

* [Cd. 3992], p. 156.

No. 10 in Appendix VII.

MALTA.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received March 14, 1908.)

MY LORD,

The Palace, Valletta, March 9, 1908.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of the 23rd December last,* communicating to this Government certain suggestions of the Advisory Committee of the Tropical Diseases Research Fund with regard to the work which is being carried out in the laboratories and research institutes of various Colonies.

2. In reply, I have the honour to inform your Lordship that there is no institution of this kind in Malta, and the Executive Council, whom I have consulted, do not consider it advisable to establish one now that the Mediterranean Fever Commission have completed their investigations.

3. I take this opportunity of forwarding, for your Lordship's information, a copy of the following reports which have been prepared by Professor Zammit, viz.:—

"Report on the goats bought suffering from Mediterranean Fever in April, 1906, and on the kids born of some of them at the Lazaretto," and
"Report on the observations made on kids fed on infected milk."

I have, &c.,

H. F. GRANT,

Governor.

Enclosure in No. 10 in Appendix VII.

REPORT on the Goats bought suffering from Mediterranean Fever in April, 1906, and on the Kids born of some of them at the Lazaretto.

The goats bought by the Commission in April, 1906, ill with Mediterranean Fever, were kept for nearly a year at the Lazaretto with a view, mainly, of observing if they would get better, or, eventually, if they would in time shake off the fever altogether.

2. Later on, I thought that it would be worth while to have these goats impregnated again with a view to observing whether the kids born from infected mothers would have acquired immunity against Mediterranean infection. The result of these observations is here tabulated.

3. For the sake of comparison, five kids were bought, born out of the Lazaretto from presumably healthy mothers, and of the same age as the kids born from our infected goats.

4. Of the eleven animals, four, including the sheep, remained barren; but of these, two continued to yield milk, which was tested to the last; the other two dried up by September.

5. Table "A" shows the result of the observations made on these animals.

6. The sheep (No. 107), which had always proved to be badly infected, remained saturated with *Micrococcus melitensis* to the last. Its milk yielded throughout a large amount of cocci, and at the post-mortem examination *Micrococcus melitensis* was abundantly obtained from practically all organs (spleen, liver, inguinal glands, and mesenteric glands). This sheep, therefore, found infected in April, 1906, never got better till August, 1907, when it was slaughtered, a period of 16 months, without, of course, taking into account the unknown period for which it was ill before it was examined. The animal during all this time showed no objective signs of its illness, it never lost flesh, it fed well, and gave abundant milk, which looked normal till it became watery, and then disappeared in January, 1907.

At the post-mortem examination the animal looked normal and very fat, the Veterinary Surgeon declaring it a first rate sheep, although he knew that it had yielded *Micrococcus melitensis* freely in the milk for months. A few sublumbar

* [Cd. 3992], p. 156.

glands were found congested, and even hæmorrhagic in points, though not much enlarged. All the other glands looked normal, but enlarged.

7. The same can be said of goat No. 117. Animal kept lively and well all through, and gave a first-rate carcase, although the *Micrococcus melitensis* was recovered in great abundance from all glands (inguinal, mesenteric, and mammary).

8. Goat No. 115 died in January, 1907, and as putrefaction had set in when it was brought over to the laboratory no post-mortem was possible. It had been ill for some time and had dried up.

9. Goat No. 104 had dried up at an early date, and had remained barren. No *Micrococcus melitensis* had been got from its milk before it dried up, and its blood had ceased to react. At the post-mortem examination it looked quite normal, and no *Micrococcus melitensis* was obtained from any of the organs examined. For all intents and purposes the goat looked cured of its attack of Mediterranean Fever.

10. The rest of the goats had a regular pregnancy, and dropped from 1 to 4 kids in due time. One of them (No. 114) died of septicæmia after dropping 3 kids.

11. The goats suckled their kids and kept quite well. Their blood and their milk reacted, more or less, all the time, except for No. 112, which persistently gave no reaction although *Micrococcus melitensis* was recovered from its milk twice in March (100 and 50 colonies per '1 c.c.), and once in May (39 colonies per '1 c.c.).

12. At the slaughtering of these goats, 16 months after their being discovered to be infected, and 6 months after delivery, the infection had greatly subsided.

13. Nos. 101 and 112 yielded no *Micrococcus melitensis* at the post-mortem examination, though No. 101 had *Micrococcus melitensis* in the milk in April (15 colonies), and its blood had shown throughout a positive reaction.

14. No. 110 gave also negative results at the post-mortem examination, but its blood showed a strong reaction, and colonies of *Micrococcus melitensis* were abundant in its milk not earlier than May and June (69 and 300 colonies per '1 c.c.).

15. No. 113 was the most curious of the set. Its milk and its blood had persistently reacted throughout, and for about a week in June (two months before the post-mortem) had yielded as much as 200 colonies per '1 c.c. of milk, yet no *Micrococcus melitensis* could be recovered from any of its organs.

16. The only goat that showed *Micrococcus melitensis* at the post-mortem was No. 111, though even this in a very unexpected manner. The animal had given positive reaction both in the milk and in the blood during life, and had started yielding *Micrococcus melitensis* in the milk since February, 1906. No *Micrococcus melitensis* was recovered in the milk from April to June 12th, but up to June 22nd the colonies were very numerous, surely over 1,000 per 1 c.c. At the post-mortem *Micrococcus melitensis* was obtained only from the inguinal glands.

17. From these observations I think it is fair to conclude that goats once infected with Mediterranean Fever, very rarely, if ever, shake it off, and also that infected goats are a constant danger, as they are apt to yield infected milk unexpectedly.

18. Another very interesting observation we made is that although as a rule an infected milk reacts when tested like blood serum for agglutination with *Micrococcus melitensis*, cases were observed when a milk full of micrococci failed to give the agglutination reaction.

19. One feels also bound to remark that of the 11 goats examined, Nos. 107, 111, and 117 only gave colonies of *Micrococcus melitensis*, and of these Nos. 111 and 117 had been treated with injection of dead colonies of *Micrococcus melitensis* about a year previously. The goats thus treated were Nos. 104, 111, 114, and 117.

REPORT on the Observations made on Kids Fed on Infected Milk.

1. Seven infected goats dropped kids at the Lazaretto in February and March, 1907:—

Goat No. 101	dropped	1 kid.
„ „ 108	„	2 „
„ „ 110	„	2 „
„ „ 111	„	1 „
„ „ 112	„	2 „
„ „ 113	„	4 „
„ „ 114	„	3 „ (1 dead in utero)

2. When more than one kid was born, one kid was killed immediately and examined. When only one was born it was allowed to live for further observations.

3. The kids were given the number of their mother so that the case could be followed more clearly.

4. The kids were allowed to suck their mothers, and only when the goat died the kids were suckled by another goat.

5. Table "B" shows the state of the kids during the experiment.

6. The main point to be observed was as to whether a kid born of an infected mother would acquire immunity to *Micrococcus melitensis* infection. For this purpose, five kids were bought of approximately the same age as those born at the Lazaretto (about 4 months) for the purpose of comparison.

7. The Lazaretto kids were left with their dams for nearly four months, when they were able to feed on clover, cotton-seed, and beans.

8. At this time all the kids were given milk from an infected goat in two doses, one draught in the evening and one next morning. After this they were finally separated from the dams.

9. As at the time both goat No. 111 and 113 yielded infected milk, those two goats were destined to give the milk for the experiment. As, however, goat No. 113 stopped to give infected milk quite suddenly, to be on the safe side all the kids fed on No. 113 milk were fed again twice on the milk of goat No. 111, which contained *Micrococcus melitensis* as before.

10. All the kids killed and examined soon after birth were found to be free from infection; their blood never reacted, and no *Micrococcus melitensis* was recovered from their organs and glands. Not one of the kids showed reaction in the blood immediately after birth; but some of them developed the reaction soon after.

11. The parallelism of the reaction of kid and mother was not maintained.

—	February 20th.	February 26th.	March 3rd.	April 16th.
GOATS.				
101	+ 1/100	+ 1/80	+ 1/100	+ 1/20
110	+ 1/50	+ 1/160	+ 1/100	+ 1/20
111	—	+ 1/100	+ 1/40	+ 1/20
112	—	+ 1/40	+ 1/20	+ 1/20
KIDS.				
101	+ 1/50	+ 1/60	+ 1/100	+ 1/20
110	—	+ 1/40	+ 1/100	—
111	—	—	—	—
112	—	+ 1/40	± 1/20	—

12. Two months after their birth all the kids showed no reaction in their blood up to their death.

In August three of the kids developed diarrhoea, and were nearly dying when they were killed, and carefully examined.

No. 101.—Bowels congested, mesenteric glands enlarged.

No. 114.—Intestines inflamed, pericardium full of serum, mesenteric glands enlarged.

No. 22.—Intestines highly congested, stomach full of undigested food, gall bladder distended with glary bile, kidneys much congested.

No *Micrococcus melitensis* was obtained from any of the organs.

Between the 1st and the 10th of October, all the kids were slaughtered and carefully examined. They all appeared in perfect condition and moderately fat. The organs in all looked perfectly healthy, the spleen normal, except in Nos. 16 and 17 in which it was friable and juicy.

Agar plates were smeared with material taken from spleen, liver, kidney, inguinal glands, mesenteric glands, heart, and bladder.

Numerous growths were obtained from No. 16 from spleen liver, inguinal glands, and mesenteric glands.

From No. 108 a few colonies were found on the plate smeared with a portion of kidney, all the other plates showed no *Micrococcus melitensis* growth.

None of the other kids gave colonies of *Micrococcus melitensis*.

13. The growths from No. 108 were quite unexpected, as the kid had never reacted to *Micrococcus melitensis* during life, and as no growth was obtained from the spleen and glands, which are much more likely to contain the microbe.

Still the infection of this kid could in no way be compared with that of No. 16, which gave pure cultures of *Micrococcus melitensis* in a large number of plates, and which had shown a good serum reaction during life.

14. Of course, the finding of the few colonies in No. 108 does not allow one to affirm that the kids born of infected mothers had acquired immunity, but taking all the circumstances together, one can easily see that the four kids bought out of the Lazaretto suffered much more severely than the others. Nos. 7, 16, and 17 gave clear reactions all the time, whilst of the Lazaretto kids the serum reaction was never evident.

15. In conclusion I think that this experiment gives us a *primâ facie* evidence that kids born of infected dams have a certain degree of immunity to the Mediterranean Fever infection.

16. If the experiment be repeated on a larger scale, and my conclusions confirmed, a clue to the grave problem of freeing the island from infected goats may have been found, as it will be comparatively an easy question to replace infected goats by immune kids.

TEM. ZAMMIT.

January 31, 1908.

TABLE "A." SHOWING STATE OF GOATS FROM SEPTEMBER, 1906, TO AUGUST, 1907.

Number of Goat.	September.			October.			November.			December.			January.			February.			March.			April.			May.			June.			July.			August.		
	M.	B.	C.	M.	B.	C.	M.	B.	C.	M.	B.	C.	M.	B.	C.	M.	B.	C.	M.	B.	C.	M.	B.	C.	M.	B.	C.	M.	B.	C.	M.	B.	C.			
101	—	+	—	—	+	—	—	+	—	—	+	dry	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—	—		
104	—	+	dry	—	+	dry	5	—	+	—	dry	dry	—	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—		
107	6,000	+	306	20	—	20	—	+	+	150	—	dry	—	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—		
108	500	—	—	—	—	—	—	+	+	dry	—	dry	—	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—		
110	—	+	—	—	+	—	—	—	+	—	—	dry	—	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—		
111	40	+	—	—	+	—	—	—	+	—	—	dry	—	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—		
112	—	+	—	—	+	—	—	—	+	—	—	dry	—	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—		
113	—	+	—	—	+	—	—	—	+	—	—	dry	—	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—		
114	500	+	10	—	+	—	50	—	+	—	—	dry	—	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—		
115	dry	+	dry	700	+	+	300	—	+	—	—	dry	—	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—		
117	200	+	+	+	+	+	+	+	+	300	—	dry	—	+	—	—	+	—	—	+	—	—	+	+	—	—	+	—	—	+	—	—	—	—		

REMARKS.

No. 101 dropped 1 kid on 15th February, killed on 29th August.
 No. 104 killed on 8th August, M.M. recovered at *post-mortem*.
 No. 107 killed on 9th August.
 No. 108 dropped 2 kids on 27th March, killed on 29th August.
 No. 110 dropped 2 kids on 10th February, killed on 16th August.
 No. 111 dropped 1 kid on 6th February, killed on 29th August, M.M. recovered at *post-mortem*.
 No. 112 dropped 2 kids on 11th February, killed on 29th August.

No. 113 dropped 4 kids on 31st March, killed on 29th August.
 No. 114 dropped 3 kids on the 8th March, killed on 29th August.
 No. 115 died on 26th January, M.M. recovered at *post-mortem*.
 No. 117 killed on 8th August.
 N.B.—M. stands for milk, B. for blood, and C. for colonies per 1 c.c. in milk.
 + stands for positive, — for negative, and $\pm$ for doubtful reaction.

TABLE "B." SHOWING BLOOD REACTION OF KIDS FED ON INFECTED MILK.

Number of Kid.	Date of Birth at Lazaretto.	February		March 4th.	April 16th.	June 20th.	July 26th.	August				September				October		
		20th.	26th.					2nd.	12th.	17th.	24th.	2nd.	9th.	17th.	23rd.	1st.	3rd.	10th.
101	15th February, 1907	$+\frac{1}{30}$	$+\frac{1}{60}$	$+\frac{1}{100}$	$+\frac{1}{20}$	—	—	Died	—	—	—	—	—	—	—	Killed	Killed	
108	27th March, 1907 ...	—	$+\frac{1}{30}$	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
110	10th February, 1907	—	—	$+\frac{1}{100}$	$+\frac{1}{20}$	—	—	—	—	—	—	—	—	—	—	—	—	
111	6th February, 1907	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
112	11th February, 1907	—	$+\frac{1}{40}$	$+\frac{1}{20}$	—	—	—	—	—	—	—	—	—	—	—	—	—	
113 A.	31st March, 1907 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Killed
113 B.	31st March, 1907 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Killed
113 C.	31st March, 1907 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Killed
114	8th March, 1907 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Killed
7	Bought June 19th	—	—	—	—	—	—	Died	—	—	—	$\pm\frac{1}{10}$	$\pm\frac{1}{10}$	$+\frac{1}{10}$	$\pm\frac{1}{20}$	Killed	Killed	
8	Bought June 19th	—	—	—	—	—	—	$\pm\frac{1}{20}$	—	—	$\pm\frac{1}{10}$	—	$\pm\frac{1}{10}$	—	—	—	—	Killed
16	Bought June 19th	—	—	—	—	—	—	$+\frac{1}{20}$	$+\frac{1}{10}$	$+\frac{1}{10}$	$\pm\frac{1}{10}$	—	$\pm\frac{1}{10}$	$+\frac{1}{10}$	$+\frac{1}{20}$	—	—	Killed
17	Bought June 19th	—	—	—	—	—	—	$+\frac{1}{20}$	$\pm\frac{1}{10}$	+	—	—	$\pm\frac{1}{10}$	$\pm\frac{1}{10}$	$\pm\frac{1}{20}$	—	—	Killed
22	Bought June 19th	—	—	—	—	—	—	Killed	—	—	—	—	$\pm\frac{1}{10}$	$\pm\frac{1}{10}$	$\pm\frac{1}{20}$	—	—	Killed

N.B.—Infected milk was given to all kids only twice between 11th June and 2nd July.

Kid No. 108—few colonies of M.M. in plate from kidney.

Kid No. 16—badly infected—M.M. in spleen, liver, inguinal glands, and mesenteric glands.

Fractions denote dilution of blood serum, + stands for positive and — for negative reaction, $\pm$ for doubtful reaction.

No. 11 in Appendix VII.

NYASALAND PROTECTORATE.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 21 March, 1908.)

Government House, Zomba,

MY LORD,

Nyasaland Protectorate, 10 February, 1908.

IN reply to your Lordship's circular despatch of the 23rd December, 1907,* dealing with the subject of medical research work in the Colonies and embodying the suggestions of the Advisory Committee of the Tropical Diseases Research Fund in regard thereto, I have the honour to inform your Lordship that I have submitted this circular to the Principal Medical Officer of the Protectorate for his remarks and observations.

2. I am informed in reply that the work at present being conducted in the local laboratory comprises:—

- (a) The determination of hoemolysin in the blood serum of patients suffering from blackwater fever, and incidentally in cases of severe malarial infections and piroplasmosis in cattle and dogs. The laboratory, the Principal Medical Officer observes, is indebted to the members of the Blackwater Fever Commission for demonstrating the technique required in the prosecution of this research.
- (b) The immunisation of a calf from *T. brucei* infection, on the lines indicated by Dr. Edington in a paper recently published by him in the "Lancet." This experimental enquiry has been undertaken at my request and in the expectation that if complete immunity from tsetse fly disease is obtainable by this means the method might with advantage be employed on an extended scale so as to render waggon traffic possible through localities known to be fly-infested.

3. With the present limited medical staff it will not be possible to second a medical officer for research work, and the Principal Medical Officer therefore proposes, in order to comply with the suggestions detailed in your Lordship's circular, to nominate the Resident Medical Officer of Zomba Director of the local laboratory, he personally collaborating with him so as in some measure to ensure continuity of the work undertaken, as these officers have their ordinary routine duties to attend to.

4. The Principal Medical Officer further observes that, as a nosological return accompanies his Annual Medical Reports, the Tropical Diseases Research Fund Committee, after perusal of these reports, would be in a position to note what diseases are met with in this country; and he ventures to suggest that in regard to paragraph 2 (iii.) of the circular it would perhaps be an advantage if the Director of the laboratory were informed from time to time in respect of which of these diseases research work could profitably be undertaken—in which directions and on what lines of enquiry.

5. I may finally add that the object of your Lordship's circular has been fully appreciated, and that the laboratory in Zomba will gladly undertake any enquiry of which it may be advised and so far as its limited resources in respect of research apparatus will permit.

I have, &c.,

W. H. MANNING,
Acting Governor.

No. 12 in Appendix VII.

SOUTH AFRICA.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 30 May, 1908.)

MY LORD,

High Commissioner's Office, Johannesburg, 11 May, 1908.

WITH reference to Lord Elgin's circular despatch of December 23rd, 1907,*

I have the honour to enclose, for your information, a copy of the undermentioned documents on the subject of tropical diseases research.

I have, &c.,
SELBORNE,
High Commissioner.

SCHEDULE OF ENCLOSURES.

1. Despatch from Acting Administrator, North-Western Rhodesia. February 21st, 1908.
2. Despatch from Resident Commissioner, Swaziland. April 16th, 1908.
3. Despatch from Resident Commissioner, Bechuanaland Protectorate, April 16th, 1908.
4. Despatch from Resident Commissioner, Basutoland. April 21st, 1908.
5. Despatch from Administrator, Southern Rhodesia. April 29th, 1908.

Enclosure 1 in No. 12 in Appendix VII.

Administrator's Office, Livingstone,
My LORD, North-Western Rhodesia, 21 February, 1908.

I HAVE the honour to acknowledge the receipt of Lord Elgin's circular, dated 23rd December, 1907, which was transmitted to me by your Lordship, dealing with the conduct of laboratorial research in the Colonies.

2. The Principal Medical Officer for this territory, while expressing his general concurrence with Lord Elgin's recommendations, takes the opportunity to observe that it will probably be some considerable time before a laboratory for pathological research is likely to be established north of the Zambesi, unless by means of outside support such as might be afforded by the Tropical Diseases Research Fund.

Southern Rhodesia, on the other hand, is provided with an admirably equipped laboratory. This, however, is at present conducted by medical officers who have also other duties to perform, and the Principal Medical Officer for North-Western Rhodesia maintains that were a pathologist and adequate staff appointed who would devote all their time to pathological research the needs of the whole of Rhodesia would be amply met.

I have, &c.,
JOHN CARDEN,
Acting Administrator.

His Excellency
The High Commissioner
The Right Honourable
The Earl of Selborne, G.C.M.G., P.C.,
&c., &c., &c.,
Johannesburg.

Enclosure 2 in No. 12 in Appendix VII.

My LORD, Resident Commissioner's Office, Mbabane, 16 April, 1908.

I HAVE the honour to acknowledge the receipt of Your Excellency's despatch, of April 10th, directing my attention to the terms of a circular letter, dated December 23rd, 1907, from the Right Honourable the Secretary of State for the Colonies on the subject of tropical diseases research.

2. The time of the only medical officer is fully occupied in actual treatment, and the finances do not admit as yet of the establishment of a laboratory. Swaziland may, for the purposes of the circular, be considered to be a part of the Transvaal, and there is no disease peculiar to the country, which is, generally speaking,

healthy, and, consequently, is not a field from which much valuable assistance to the research is likely at any time to be afforded. I shall, however, bear in mind the provisions of the circular for consideration if necessary at some future date.

3. I have to express my regret at the delay in this reply.

I have, &c.,

R. T. CORYNDON,

Resident Commissioner.

The Right Honourable

The Earl of Selborne, P.C., G.C.M.G.,

&c., &c., &c.

Enclosure 3 in No. 12 in Appendix VII.

MY LORD,

Resident Commissioner's Office, Mafeking, 16 April, 1908.

I HAVE the honour to acknowledge the receipt of Your Excellency's despatch of the 10th instant, calling attention to the Secretary of State's circular despatch of December 23rd, 1907, on the subject of tropical diseases.

2. I regret the delay in replying, but it was one of the matters which apply to large Colonies and it was overlooked.

3. I am sorry to say we have neither the funds available, nor the staff, to enable us to establish laboratories, &c., as suggested.

I have, &c.,

F. W. PANZERA,

Resident Commissioner.

His Excellency

The High Commissioner,

Johannesburg.

Enclosure 4 in No. 12 in Appendix VII.

Resident Commissioner's Office, Maseru,

MY LORD,

Basutoland, 21 April, 1908.

IN reply to the inquiry contained in Your Lordship's despatch of 10th April, 1908, I have the honour to state that, there being no laboratory for research work belonging to this Administration, it is regretted that little assistance can be rendered in the field of tropical disease research.

Any assistance which in spite of this limitation may still be in the power of the medical officers of the Administration will, I need hardly say, be most willingly rendered.

I have, &c.,

H. C. SLOLEY,

Resident Commissioner.

His Excellency

The Right Honourable

The Earl of Selborne, P.C., G. C. M.G.,

High Commissioner, South Africa.

Enclosure 5 in No. 12 in Appendix VII.

MY LORD,

Administrator's Office, Salisbury, 29 April, 1908.

I HAVE the honour to acknowledge the receipt of your Lordship's despatch of the 10th instant, drawing my attention to the circular from the Secretary of State on the subject of tropical diseases research in the Colonies.

2. There is at present no laboratory or research institution in Southern Rhodesia, and I am unable, therefore, to carry out Lord Elgin's suggestions for the time being, but in the event of such an institution being established, I consider that it would be of the greatest advantage to associate its operations, on the lines

indicated in the circular, with the Tropical Diseases Research Committee, who possess exceptional opportunities for distributing information as to past work, and whose records would materially assist the Directors of Colonial laboratories.

I have, &c.,

W. H. MILTON,
Administrator.

His Excellency
The High Commissioner,
Johannesburg.

TROPICAL DISEASES RESEARCH FUND.

REPORT

OF THE

ADVISORY COMMITTEE FOR THE TROPICAL DISEASES RESEARCH FUND

FOR THE YEAR 1909.

(For Report for 1908 see [Cd. 4476], March, 1909.)

Presented to both Houses of Parliament by Command of His Majesty.
February, 1910.



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Appendix I.

Reports on measures taken for the prevention of Malarial Fever	...	...	...
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1909.					
1	To the Governors of certain Colonies and Protectorates.	Circular	March 31	Transmits copy of a letter to "The Times" by Dr. William Osler on the subject of Malaria in Italy; also a copy of a report by the correspondent of "The Times" on the proceedings of the Bombay Medical Congress, and enquires to what extent the policy referred to by Dr. Osler could be adopted in the Colonies concerned.	4
2	The Acting-Governor.	Ceylon	June 16 (Rec. July 6.)	Encloses, in reply to No. 1, a copy of a report by the Principal Civil Medical Officer describing the measures taken to check malarial fever in Ceylon during 1908.	9
3	The Governor ...	Mauritius	June 21 (Rec. July 24.)	Transmits copy of a report by the Acting Medical Director showing that the policy pursued in Italy has already been adopted in Mauritius, and appends copy of correspondence with the Mayor of Port Louis with regard to the commencement of extensive anti-malarial works in that town.	11
4	The Acting-Governor.	East Africa Protectorate.	May 3 (Rec. June 12.)	Transmits a memorandum by the Principal Medical Officer on the application in the Protectorate of the measures taken to combat malaria in Italy.	13
5	Principal Medical Officer.	East Africa Protectorate.	May 31 (Rec. Aug. 14.)	Report on the measures directed towards the eradication of malarial fever and other mosquito-borne diseases.	14
6	Dr. J. A. Haran, Medical Officer of Health, Mombasa.	East Africa Protectorate.	(Rec. Aug. 14.)	Report on the measures taken in Mombasa to prevent the breeding of the mosquito larvæ.	15
7	The Governor ...	Nyasaland Protectorate.	May 22 (Rec. July 3.)	Transmits a copy of a memorandum prepared by the Principal Medical Officer on the subject of the adoption in Nyasaland of the means employed in Italy to prevent malaria, and points out that little such work can be done in the scattered native villages of the Protectorate.	16

Serial No.	From or to whom.	Colony, &c.	Date.	Subject.	Page.
			1909.		
8	The Principal Medical Officer.	Nyasaland Protectorate.	May 31 (Rec. July 3.)	Extract from the Medical Report on the Health and Sanitary Condition of the Protectorate for 1908-9 dealing with anti-malarial measures.	17
9	The Commissioner	Somali-land Protectorate.	April 19 (Rec. May 8.)	Transmits copy of a letter from Dr. Paget on the policy of Dr. Osler.	18
10	Senior Medical Officer.	Somali-land Protectorate.	April 19 (Rec. May 8.)	Transmits supplementary Report by the Senior Medical Officer on Malarial Prophylaxis.	18
11	The Acting - Governor.	Uganda Protectorate.	July 2 (Rec. Aug. 5.)	Encloses a copy of a letter from the Principal Medical Officer on the subject of the application in the Protectorate of the measures used in Italy.	20
12	The Governor ...	Gambia	May 9 (Rec. May 31.)	Transmits copy of a report by the Senior Medical Officer stating the steps already taken in the matter ; proposes to adopt his suggestion with regard to the distribution of quinine.	20
13	Ditto ...	Gambia	May 12 (Rec. May 31.)	Forwards copy of a special report by the Senior Medical Officer on anti-malarial measures ; proposes to adopt the suggestion of a free distribution of quinine, and adds that the Legal Assistant has been instructed to prepare an Ordinance to assimilate the law on sanitary matters with that of the other West African Colonies.	21
14	The Acting - Governor.	Gold Coast.	May 20 (Rec. June 9.)	Remarks generally on the prophylactic measures suggested for the prevention of malaria, and encloses an extract from a minute by the Principal Medical Officer on the subject.	23
15	The Governor ...	Sierra Leone.	May 7 (Rec. May 25.)	Encloses copy of a report by Dr. Forde on the free distribution of quinine.	24
15A	The Principal Medical Officer.	Sierra Leone.	December 7	Reports on the measures taken during 1908 to prevent the occurrence of tropical diseases.	25
16	The Acting - Governor.	Northern Nigeria.	June 4 (Rec. July 8.)	Encloses a copy of a minute by the Principal Medical Officer to whom No. 1 was referred.	26
17	Ditto ...	Southern Nigeria.	May 27 (Rec. June 16.)	Transmits copies of two letters from the Principal Medical Officer explaining what is being done locally to combat malaria.	26
18	The High Commissioner.	South Africa.	June 30 (Rec. July 17.)	Encloses copies of despatches from the Resident Commissioners of Basutoland, Swaziland, and the Bechuanaland Protectorate, the Administrator of Southern Rhodesia, and the Acting Administrator of North - Western Rhodesia respectively on the subject of the prevention of malaria.	27
19	The Medical Officer, Bechuanaland Protectorate.	South Africa.	(Rec. Aug. 14.)	Report on anti-malarial measures in the Protectorate during 1908-9.	31

Serial No.	From or to whom.	Colony, &c.	Date.	Subject.	Page.
			1909. —		
20	The Governor ...	Bahamas	September 3 (Rec. Sept. 28.)	States that in 1907 his Government adopted his recommendation that quinine be placed on sale at cost price in every district of the colony.	32
21	The Acting - Governor.	British Guiana.	August 5 (Rec. Aug. 23.)	Reports the steps taken to bring about the gratuitous distribution of quinine on systematic lines, and encloses a copy of a circular letter to all the sugar estates.	32
22	The Surgeon-General.	British Guiana.	(Rec. Nov. 15.)	Reports upon malarial fever and anti-malarial measures adopted during 1908-9.	33
23	The Governor ...	British Honduras.	May 20 (Rec. June 7.)	Forwards copy of a Minute by the Colonial Surgeon respecting the policy pursued in Italy in preventing malaria.	34
24	The Colonial Surgeon.	British Honduras.	May 4 (Rec. Aug. 2.)	States the steps taken to eradicate malaria and to prevent its recurrence.	35
25	The Acting - Governor.	Jamaica	July 14 (Rec. July 29.)	States that arrangements are being made for the issue of quinine throughout the malarious districts of the island by the Government at cost price.	35
26	Ditto ...	Leeward Islands.	August 6 (Rec. Aug. 23.)	Reports the steps taken to distribute quinine and to enforce the adoption of prophylactic measures.	36
27	Ditto ...	Leeward Islands.	August 16 (Rec. Sept. 6.)	Reports the great success which has attended the experiment of stocking the waters of the Colony with the fish known as "millions" as an anti-malarial measure.	37
28	Surgeon - General's Annual Report for 1908-9.	Trinidad	June 12 (Rec. Oct. 3.)	Observes that the Colony's character for unhealthiness is undeserved, and states the measures taken to banish malaria from the island.	38
29	The Governor ...	Windward Islands (Grenada).	May 20 (Rec. June 15.)	States that the Executive Council in Grenada is of opinion that malarial fever is not widespread in the Colony, and that the free distribution of quinine does not therefore seem to be justified.	39
30	The Governor-General.	Australia	October 21 (Rec. Nov. 27.)	Forwards copies of communications on the subject from the Governments of Queensland, South Australia, and Western Australia.	39
31	The High Commissioner.	Cyprus	April 27 (Rec. May 8.)	Encloses six copies of the report of a Commission of Enquiry into certain evils brought about by the irrigation works in the Messaoria.	41
32	Ditto ...	Cyprus	September 22 (Rec. Oct. 2.)	States the action taken on the measures recommended by the Hygienic Subcommittee of the Commission.	42
33	Ditto ...	Cyprus	November 25 (Rec. Dec. 4.)	Transmits copy of a report by the Chief Medical Officer showing improvement effected by the measures taken to remove the sources of malaria in the affected villages of the Messaoria.	42

Appendix II.

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Abstract of work on the experimental treatment of Trypanosomiasis carried out during the present year under the supervision of a Sub-Committee of the Royal Society	43

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Report of the Professor of Protozoology on the work of the session ended 30th June, 1909	45
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Appendix IV.

Report on work of Quick Laboratory for 1909	58
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Appendix V.

Reports from London School of Tropical Medicine.

Serial No.	From or to whom.	Colony, &c.	Date.	Subject.	Page.
1	London School of Tropical Medicine.	—	1909. — May 7	Encloses the half-yearly reports on Arthropodology, Helminthology, and Protozoology, together with other documents.	59
2	Ditto	—	November 3	Encloses the half-yearly reports of the special departments.	65

Appendix VI.

Reports from Liverpool School of Tropical Medicine.

1	Liverpool School of Tropical Medicine.	—	April 30	Encloses reports by Doctors Stephens and Breinl, and Mr. Newstead for the six months ended 30th April.	69
2	Ditto	—	October 30	Encloses half-yearly reports by heads of departments showing the manner in which the Government grant has been extended.	74

Appendix VII.

Reports on work done in Colonial Laboratories.

1	The Governor ...	Barbados	July 9 (Rec. July 26.)	Encloses copy of a minute by Dr. John Hutson on the reports from the Tropical Schools of Medicine and from the Hong Kong Laboratory.	78
2	The Acting - Governor.	British Guiana.	July 21 (Rec. Aug. 9.)	Encloses the report of the Government Bacteriologist on the work carried on by Professor Deycke at the Leper Asylum.	79
3	Professor Deycke ...	British Guiana.	July 30 (Rec. Oct. 4.)	Reports on his work in British Guiana in the treatment of leprosy.	84
4	The Governor ...	British Guiana.	October 30 (Rec. Nov. 15.)	Transmits a report by the Government Bacteriologist on tropical disease research work done during the half-year ended 30th September, 1909.	90
5	The Acting - Governor.	Ceylon	August 3 (Rec. Aug. 23.)	Forwards a report on the research work done in the clinic for tropical diseases and bacteriological institute during the half-year ended 30th June, 1909, by Dr. Castellani.	98

Serial No.	From or to whom.	Colony, &c.	Date.	Subject.	Page
			1909. —		
6	The Governor ...	East Africa Protectorate.	February 8 (Rec. March 6.)	Forwards a copy of a report by the Principal Medical Officer submitting the report of the Bacteriological Department for the half-year ended 31st December last.	110
7	Ditto ...	East Africa Protectorate.	October 6 (Rec. Nov. 6.)	Transmits the report of the work done in the Nairobi Laboratory for the half-year ending 30th June, together with a covering letter from the Principal Medical Officer.	117
8	The High Commissioner.	Federated Malay States.	November 2 (Rec. Nov. 27.)	Transmits copy of a letter from the Resident General forwarding the report of the Director of the Institute of Medical Research on the work of the Institute for the period 1st April to 30th September, 1909.	123
9	Medical Officer, Batu Gajah.	Perak	(Rec. Sept. 20.)	Memorandum on the use of parboiled rice for beri-beri patients.	130

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Circular (dated 11th March, 1909) to Governors transmitting Report of the Advisory Board for 1908 133

TROPICAL DISEASES RESEARCH FUND.

REPORT

OF THE

ADVISORY COMMITTEE FOR THE TROPICAL DISEASES RESEARCH FUND FOR THE YEAR 1909.

The Advisory Committee for the Tropical Diseases Research Fund was constituted by the Secretary of State for the Colonies in July, 1904, and is now composed as follows:—

The Right Honourable Sir J. WEST RIDGEWAY, G.C.B., G.C.M.G.,
K.C.S.I., P.C. (Chairman).
Sir THOMAS BARLOW, Bart., M.D., K.C.V.O.
Sir THOMAS HOLDERNESS, K.C.S.I.
Sir CHARLES LUCAS, K.C.M.G., C.B.
Sir PATRICK MANSON, M.D., K.C.M.G., F.R.S.
Dr. J. ROSE BRADFORD, F.R.S.
Surgeon-General A. M. BRANFOOT, C.I.E., I.M.S.
Mr. H. J. READ, C.M.G.
Major RONALD ROSS, C.B., F.R.S.
Mr. A. BERRIEDALE KEITH (Secretary).

During the year the Committee lost, through death, the services of Sir Ralph Moor, K.C.M.G., who was one of the original members appointed by Mr. Lyttelton in 1904. They desire to place on record their great appreciation of the services to the cause of tropical medicine rendered by Sir Ralph Moor, both as a member of the Committee and in other capacities.

The revenue of the Tropical Diseases Research Fund for the year 1909 was made up as follows:—

Contribution from the Imperial Government	...	...	£1,000
Contribution from the Government of India	...	...	500
Contribution from the funds at the disposal of the Rhodes' Trustees	...	...	200
			£1,700

Contributions from Colonial Governments in the following proportions:—

Commonwealth of Australia	...	...	£200
Southern Nigeria	...	...	350
Gold Coast	...	...	200
Ceylon	...	...	100
Straits Settlements	...	...	100
Federated Malay States	...	...	100
Hong Kong	...	...	100

Carried forward ... £1,150

	Brought forward ...	£1,150	
Trinidad ...	...	100	
Fiji ...	...	100	
Sierra Leone ...	...	100	
Gambia ...	...	100	
British Guiana ...	...	100	
Grenada ...	...	50	
St. Kitts-Nevis ...	...	25	
Dominica ...	...	25	
St. Vincent ...	...	20	
			1,770
making in all a total of ...	...	...	£3,470

The expenditure of the year consisted of grants as follows :—

Grant to the London School of Tropical Medicine	£1,383	6	8
Grant to the Liverpool School of Tropical Medicine ...	1,000	0	0
Grant to the University of London ...	750	0	0
Grant to the University of Cambridge ...	200	0	0
making in all a total of ...	£3,333	6	8

Of the grant to the Liverpool School of Tropical Medicine (£1,000) half was employed by the School for the appointment and salaries of a Lecturer in Economic Entomology and Parasitology and of a Lecturer in Tropical Medicine. Both these lecturers are required to devote their spare time to research. The other half of the grant was used in connection with the expenses of the research work on tropical diseases which is being carried on at the Runcorn Laboratory of the School.

Of the grant of £1,383 6s. 8d. to the London School, a sum of £1,000 was devoted to the payment of the salary of a Teacher and Investigator of Protozoology, and of the salary of a Teacher and Investigator of Helminthology, and to the maintenance of the laboratories. The sum of £333 6s. 8d. was employed in defraying the expenses in connection with the appointment of an Arthropodologist, whose post was established in 1907 by means of a grant from the Tropical Diseases Research Fund, and a sum of £50 was granted towards defraying the cost of the increased accommodation rendered necessary by the number of students attending the School.

The grant of £750 to the University of London was expended in paying the salary of the Professor of Protozoology, established in 1906 by means of a grant from the Fund.

Of the grant of £200 to the University of Cambridge, £100 was made in respect of the Research Studentship in medical entomology established in 1907 by means of a grant from the Fund, while £100 was granted in respect of general expenses of the Quick Laboratory on the application of Professor G. H. F. Nuttall. This grant was made in recognition of the importance of the laboratory to workers from the Colonies and of the assistance rendered to investigators by Professor Nuttall.

As in 1908, no grant was made to the Royal Society from the Fund during the year, because it was found possible to provide from the funds of the Uganda Protectorate the sums required for the continuation of the researches into sleeping sickness which have been carried on under the supervision of the Society.

As the period for which the grants from the Imperial Government, the Government of India, and the Colonial Governments should be made was originally fixed in 1904 at five years, the Secretary of State early in the year invited the opinion of the Advisory Committee as to whether the work done by means of the funds subscribed rendered it desirable that the contributions should be maintained. The Committee expressed in the most emphatic manner their opinion that the work which had been and is being done at the expense of the fund is of the highest value, and that it would be a calamity if the teaching and researches were to be restricted by any shortage in the contributions. The Secretary of State accordingly invited the Colonial Governments in a despatch of the 11th of March* to continue their contributions for a further period of five years, and the Committee have

learned with satisfaction that the Colonial and Protectorate Governments to whom this circular was sent have readily responded to the request.

The Imperial Government and the Government of India have likewise undertaken to continue their contribution to the fund for a further period of five years. The Committee are also glad to learn that there is a prospect of further small contributions being received from Colonies which have not hitherto made a payment towards the Fund.

The Committee have learnt with pleasure that the Australian Institute of Tropical Medicine, towards the establishment of which a grant of £400 was made from the Fund in 1908, has now been definitely constituted and a Director has been appointed, Dr. A. Breinl, of the Liverpool School of Tropical Medicine, whose experience and qualifications make them confident that the work done by the Institute will be of great value. They understand that there is no doubt that adequate contributions for the maintenance of the Institute will be raised in Australia, and they are glad to learn that both the University of Sydney and that of Melbourne are interested in the matter.

The Committee have noted with satisfaction that the establishment of the Sleeping Sickness Bureau has amply fulfilled the hopes which were expressed in their report for 1908.

The Bureau, on the Managing Board of which the Advisory Committee is represented by Sir West Ridgeway, Sir Patrick Manson, Dr. Rose Bradford, and Mr. Read, issues at short intervals bulletins summarising all the recent scientific work as to the origin and treatment of sleeping sickness, and has published a bibliography on sleeping sickness, giving references to all the work done on the subject since the disease was first noticed.

The Committee were consulted during the year by the Secretary of State with regard to the proposed enlargement of the Medical Research Institute for West Africa at Lagos. After discussion with the Director of the Institute, they recommended that the plans for the extension of the building should be carried out at an estimated cost of £2,350 approximately. It is anticipated that the alterations suggested will obviate many of the defects of the present structure as regards accommodation, difficulties of ventilation, and the consequent heat of the laboratory.

The Committee have learned with pleasure that it has been found possible to establish a small bacteriological laboratory at St. Lucia, and to appoint a bacteriologist to that island, and they hope in their next report to be able to include some record of the work done in the laboratory.

The Committee have followed with interest the steps taken to combat malaria in tropical Colonies. They append to the report a copy of a circular despatch addressed by the Secretary of State on the 31st of March to all the tropical colonies in which malaria is prevalent, dealing with the preventive measures adopted in Italy against the spread of malaria, and enquiring to what extent the same measures can be adopted in those colonies. From the replies, copies of which are also appended, it will be seen that, considering their limited resources and the difficulties in the way, much has been done in the tropical colonies generally to combat malaria. The Committee would call special attention to the full and excellent statistics contained in the report from Ceylon. It will be seen from the report received from Mauritius how much can be done in this direction at a small outlay.

The Committee also append reports of the work done at the Liverpool and London Schools of Tropical Medicine for the year November, 1908, to October, 1909; the report of the Professor of Protozoology at the University of London; the report of Professor Nuttall on the work done by the research student in Entomology at the University of Cambridge and in the Quick Laboratory; a report on work done in the experimental treatment of trypanosomiasis under the supervision of a Sub-Committee of the Royal Society, and reports on the work done at several Colonial laboratories which have been sent in accordance with requests made by the Secretary of State in December, 1906, and December, 1907. In these reports will be found full details of the investigations carried out, and of the papers published in connection with the grants made by, and under the supervision of, the Board.

WEST RIDGEWAY,
Chairman.

A. BERRIEDALE KEITH,
Secretary.

7 February, 1910.

APPENDIX I.

REPORTS ON MEASURES TAKEN FOR THE PREVENTION OF
MALARIAL FEVER.

No. 1.

THE SECRETARY OF STATE to THE GOVERNORS, &c.*

(Circular.)

SIR,

Downing Street, 31st March, 1909.

I HAVE the honour to transmit, for your information, a copy of a letter addressed to the Editor of "The Times" by Dr. William Osler, the Regius Professor of Medicine in the University of Oxford, on the subject of "Malaria in Italy: a lesson in practical hygiene"; and also a copy of a report by the correspondent of "The Times" on the proceedings of the Bombay Medical Congress.

2. I shall be glad to learn to what extent the policy which Dr. Osler represents as having been so successful in Italy could be adopted in the territory under your administration.

I have, &c.,
CREWE.

Enclosure 1 in No. 1.

"THE TIMES," Monday, March 15, 1909.

MALARIA IN ITALY: A LESSON IN PRACTICAL HYGIENE.

To the Editor of "The Times."

SIR,

WE owe much to the Italians for their contributions to our knowledge of the cause of malaria. Laveran's great discovery was promptly fathered by Marchiafava and Celli and Golgi, and it was through their writings that we obtained the fullest details of the nature and structure of the malarial parasite. As an old student of the disease and deeply interested in the practical problems of its prevention, one of my first visits in Rome was to the Laboratories of Pathology and of Hygiene to find out from the Directors, Marchiafava and Celli, the progress of the battle. It was not enough to know the cause; we had to know how it worked before effective measures could be taken, and the demonstration by Ross of the transmission of the disease by the mosquito at once put malaria on the list of easily preventible infections. Just ten years ago the Italian Society for the Study of Malaria was founded, and I was able to get a full report of the work.

But before speaking of it let me give the graphic picture of the ravages of malaria which I found in an interesting volume by M. R. de la Blanchère—"Un Chapitre d'Histoire Pontine: état ancien et décadence. Paris: Imprimerie Nationale, Paris, 1889"—for which I am indebted to Dr. Ashby, Director of the British School.

Speaking from sad personal experience Blanchère expresses the hopelessness with which this terrible scourge was regarded and the tragic consequences of an infection:—

Qui peut lutter contre la fièvre? Il faut n'avoir jamais senti le froid profond dont elle vous enveloppe, l'abattement étrange où elle jette les plus braves, la faiblesse, le dégoût général, la misère intérieure qu'elle laisse après elle, pour croire que, de gaieté de cœur, des hommes ont pu s'y exposer. Le fiévreux, au moment de l'accès, est retranché de l'existence; il ne lèverait pas un doigt pour écarter la mort de lui, viendrait-elle sous la figure d'un train, du feu, d'une bête féroce. Ensuite, sous le coup d'accès nouveaux, ou attendant leur venue périodique, sans appétit, trouvant le vin mauvais, le pain pâteux, les viandes amères, il languit parfois des années—s'il ne peut changer de climat. Puis le cachexie s'établit, le foie s'engorge, la rate gonfle, le cœur se distend, le teint est jaune, le ventre énorme, tant qu'un jour une

* Somaliland Protectorate, Barbados, Sierra Leone, Gambia, Gold Coast, British Honduras, Windward Islands, Southern Nigeria, East Africa Protectorate, Ceylon, South Africa, Northern Nigeria, Uganda Protectorate, Nyasaland Protectorate, Mauritius, Jamaica, British Guiana, Bahamas, Bermuda, Leeward Islands, Trinidad, Australia (for Papua).

fièvre pernicieuse enlève l'homme en quelques heures, s'il n'est pas mort plus lentement de souffrance et de consommation. En pays malarique, tout est fièvre; malaise, blessures, accidents, maladies de toute nature se compliquent de cet élément; elles le trouvent maître de l'organisme, on l'y éveillent, on l'y laissent. La fièvre de malaria est un véritable Proteus, elle revêt toutes les formes, elle attaque de mille façons. Tantôt brutale, soudaine, ou même instantanée, elle foudroie; j'ai vu des malheureux tomber dans le sillon, mourants, au milieu même de leur besogne; tantôt elle s'insinue doucement, d'abord éphémère, puis fréquente, irrégulière comme incertaine, puis tierce ou quarte, puis prenant une périodicité à longs termes. Alors elle ne quitte plus son homme; pendant trois ans, tous les vingt jours j'ai eu une semaine de fièvre. Si pleinement, si douloureusement, que l'étranger l'expérimente, il ne la connaît pas dans toute sa cruauté . . . Anémique, hyper-splénique, bilieux, les reins à demi atrophiés ou hypertrophiés, au contraire, les poumons désorganisés, les muscles flasques et mal nourris, le sang chargé d'un pigment noir qui empâte tous les viscères, il n'est plus à recevoir le miasme; il offre un terrain préparé, véritable milieu de culture; il est saisi presque en naissant. Son facies n'est pas encourageant pour le travailleur de campagne qui, descendu des Montagnes Samnites, vient labourer ou moissonner les champs du Vélitame ou de l'Antiante—tristes champs où, comme dit le poète—

Tra è solchi rei de la Saturnia terra
Cresce perenne una virtù funesta,
Che si chiama la Morte.

A graphic, first-hand, and not overdrawn picture! But his opening question, "Qui peut lutter contre la fièvre?" is answered on the spot by the splendid work of the Italian Society for the Study of Malaria. In Professor Celli's lecture-room hangs the mortality chart of Italy for the past 20 years. In 1887 malaria ranked with tuberculosis, pneumonia, and the intestinal disorders of children as one of the great infections, killing in that year 21,033 persons. The chart shows a gradual reduction in the death-rate, and in 1906 only 4,871 persons died of the disease, and in 1907 4,160. This remarkable result has been very largely due to the sanitary measures introduced by the society. It has long been known that malaria disappears "spontaneously." The Fen country is now healthy; parts of Canada about Lakes Ontario and Erie which were formerly hotbeds of the disease are now free. This cannot be attributed altogether to cultivation and drainage. I know places on the shores of the lakes just mentioned in which the conditions to-day are identical with those which I remember as a boy. The Desjardin Canal Marsh at the extreme western end of Lake Ontario was a well-known focus of the disease. The marsh remains, the mosquitoes are there; but a case of malaria is almost as rare as in England. The disappearance is largely due to the free use of quinine. The settlers early recognised the important fact that malaria was a disease liable to recur, and it became a common practice to take Peruvian bark every spring and autumn for a year or two after an attack. This is a point in prophylaxis which the work of the Italian Society has brought into prominence. From the summary of the decennial report just issued, the following paragraphs are of interest:—

The society has improved the prophylaxis of malaria, and has introduced into practice the new mechanical measures based on the defence of the habitation and the individual from the bites of mosquitoes. This being a relatively expensive procedure, the society has occupied itself chiefly with the improvement of the anti-plasmodic prophylaxis—the administration of quinine.

For this purpose it has promoted and defended legislation for the gratuitous distribution of quinine to the poor and to all workers in malarial localities.

In order to render possible the prophylaxis and to prolong the treatment, it has prepared the quinine in its most agreeable forms—namely, that of comfits and chocolates, the latter containing tannate of quinine, which has little taste and is better tolerated by children.

The results have been that since 1902, when the law on State quinine was promulgated, while the consumption of quinine has been yearly increasing, the mortality from malaria has diminished from about 16,000 to about 4,000 yearly; and in the army, Customs House offices, and some communes

where the new laws have been better applied, the morbidity from malaria has greatly diminished.

By these measures, and "by means of the agricultural and agrarian transformation of the land and colonization, rather than by the destruction of mosquitoes (a thing impossible to be done by us on a large scale)," Italy may be freed from the scourge.

Malaria illustrates stages through which so many of the great discoveries in medicine have had to pass. At first a period of doubt—that the actual germ had been discovered seemed too good news to be true, and for ten years or more there was much, and perhaps justifiable, scepticism. Except for the great help in diagnosis, we did not get much further until 1898, when the experiments of Ross demonstrated the truth of the old suggestion of Lancisi (revived by King and by Manson), that the disease was transmitted by the mosquito. And now we are in a stage of prevention—the practical application of the knowledge of the cause and the method of its action. The anti-malarial crusades initiated by Ross have had an extraordinary success, and nowhere more than in Italy, in the hands of the National Society, to whose good work it is a pleasure to call attention. It would be hard to name any single event of the nineteenth century of greater practical importance to the race than the discovery of Laveran. In the words of Colonel Gorgas, it has made the tropics habitable by white men. The Panama Canal zone is an astounding witness to the success of modern sanitary measures against malaria. The monthly reports of Colonel Gorgas give a death-rate (among nearly 50,000 work-people) lower than that of any large city—it has been as low as 12 per 1,000! And let us not forget that humanity owes this triumph to the men who introduced experiment into medicine, to the Harveys, the Hunters, the Majendies, and the Claude Bernards—the arch-vivisectors whom it has become fashionable to abuse!—and who have thus enabled us to wring from nature what Harvey calls "her closet-secrets."

WILLIAM OSLER.

Rome, March 3rd.

Enclosure 2 in No. 1.

"THE TIMES," Tuesday, March 16, 1909.

THE BOMBAY MEDICAL CONGRESS.

(From a Correspondent.)

Bombay, February 27.

When Sir George Clarke opened the Medical Congress here on February 22nd he expressed the hope that it would prove a landmark in the history of medical progress. The congress has been in every respect so successful that it seems already to appear as a landmark. In an article published early in January some account was given of the origin, the aim, and the scope of the congress, and to that nothing need now be added except a record of the fact that the arrangements in connexion with it were excellently made by Lieutenant-Colonel Jennings, I.M.S., the honorary secretary of the congress. Of the actual transactions little more than a brief outline can be given, for the number of papers that were read and of subjects that were dealt with was large. A congress that is divided into five sections, in each of which five or six papers are read every day, can get through a large amount of business in a four days' session.

Malaria.

Much attention naturally was devoted to malaria, and Major Ronald Ross had a large audience when he read his long address on the practice of malaria prevention, and when he delivered a popular lecture on the subject. He showed in detail what had been done in Mauritius, and made suggestions that will be of the greatest value in India, and not least of all in Bombay, which has suffered much from malaria. What he advocates may be summarised in a sentence: mosquito destruction in large towns, quinine in the country districts, with the two methods simultaneously combined where severe malaria is present. A paper on the human factor in malaria, by Captain S. R. Christophers and Dr. Charles A. Bentley, dealt with another aspect of the question. These authorities have found that in a community composed of malaria-stricken subjects in a state of physiological poverty and

exposed to hardship, infection diminishes very slowly, even in the absence of anopheles, and the presence of even a very small number of anopheles appears to be quite sufficient to keep up the *maximum* degree of parasitic infestation. This "factor of residual infection" may thus convert a whole community into a reservoir of infection ever ready to involve its neighbourhood in epidemic sickness, and capable, on the migration of its members, of diffusing malaria infection far and wide. If one considers the conditions of coolie labour in India it is not difficult to understand, on the foregoing hypothesis, that the "greatest exaltation of malarial infection" may readily be set up, that new centres of infection are set up in places distant from the original source, and that an unending train of vicious circles is set in motion resulting in a widespread epidemic. The development of the country requires an aggregation of labour, and that, in tropical conditions, means that malaria must be associated with it. The originators of this theory explain by it the series of vast epidemics of malaria that have ravaged Bengal during the last 40 or 50 years. In view of the development of the coal and other industries in this country they look to the future with apprehension; they point out the inadequacy of mosquito destruction alone in dealing with an exaltation of malaria due to the action of factors affecting the human host, and advocate efforts to minimize the effects of hardship, exposure, bad housing, poor and insufficient food supply, and impure water, and the overcrowding of sites and dwellings.

Plague.

To Bombay no subject is of more importance than plague, and that was discussed from almost every point of view. A few points only can be mentioned here. Professor Kitasato, of Japan, sent a paper, which was read by Professor Shiga. This was remarkable as showing that Japanese medical men have now adopted the Indian explanation of the transmission of plague by fleas—a theory which a few years ago found no supporters in Japan. In another paper, by Captain Liston, I.M.S., the various prophylactic measures were discussed at length. In regard to inoculation, he said that there could now be no question of the efficiency of this method of combating the disease; by it one could guarantee that at least six times as many lives would be saved as would be saved without it. One paragraph in his paper was very significant, and it is to be hoped it will have some effect. "There is," he said, "very good evidence that already we have become faint-hearted. The annual expenditure on plague measures in Bombay City, for example, has fallen from more than twelve lakhs to something under two. It is time we took courage again, and now with open eyes endeavoured to purge this fair city of the blight which has spread and still continues to spread from it over India."

The fault, however, is not Bombay's alone. In a discussion on the regulations imposed upon Mahomedan pilgrims from India to Mecca, it was shown that it has been possible to prevent the importation of cholera and plague from Bombay to Camaran, the quarantine lazaretto in the south end of the Red Sea. The reverse does not apply, for pilgrims bring back a number of diseases from Mecca and Medina, which are notoriously insanitary, and the question is one to which the attention of Turkey is repeatedly being drawn.

Snake Bites.

A valuable discussion followed the reading of various papers on snake venom and the means of preventing death from it. Sir Lauder Brunton contributed a paper in which he enunciated, what is now fairly familiar even to the layman, his theory that "permanganate of potash is a complete antidote to snake venom if it is quickly applied in sufficient quantity and in the proper way." In this case the mode of application is to tie a bandage tightly over the limb above the bite, to convert the punctured wound of the bite into a clean cut with a lancet, and to rub in the permanganate, moistening it with water. A case containing lancet and permanganate is sold in India for a few pence. It was found that little faith was put in this remedy. Surgeon-General Benson, in his address as one of the sectional presidents, said that though cases of cure had been reported little reliance could be placed on it, and the discussion produced similar views. It is objected that the experiments which appear to support Sir Lauder Brunton are inconclusive, and that there is difficulty—assuming the value of permanganate of potash—in bringing the poison and antidote into intimate contact in the tissue. When a snake bites the poison is deposited not in the skin itself, but in the areolar tissue beneath,

and as the skin is freely movable the fangs may drag it away from its proper position before the poison is injected: in this way it happens that the poison is not deposited immediately beneath the punctures. Major Wall suggested that there was no difficulty in bringing the two substances into intimate relationship in the system if the permanganate was injected into the blood stream instead of into the tissues, and it is hoped that experiments may be carried out with the idea of showing whether this is correct. It is true that several cases of snake bite in man have been treated by Sir Lauder Brunton's method with the happiest results, but the evidence in such cases is incomplete, as the snake may not have been poisonous (many persons have been known in such a case to die of fright), or a lethal dose of venom may not have been injected. On the other hand, experiments on monkeys made in the most favourable conditions have failed.

The treatment by sera was discussed also, but it appears that no serum has yet been produced which can be advantageously used in cases of bites of all species of snakes, and this difficulty is at present insurmountable. The serum which is now issued from the Central Research Institute, Kasauli, for use in India, is prepared with a mixture of cobra and daboia venom, and is therefore useful only in cases of bites from one or other of these species, and no good can be hoped from its use in cases of bites of other species. There are known to be 39 species of poisonous terrestrial snakes in India, besides about 30 species of sea snakes, but the Kasauli "polyvalent antivenene" is believed to be a specific in the bites of two only of these many species. Calmette of Lille, who was the first to establish that an animal which had been treated over a length of time with snake venom yields a serum which is antitoxic to that poison, is now, said one speaker, the only person who does not agree that anti-venomous sera are highly but not strictly specific.

Beri-Beri.

Among the many other subjects which the congress dealt with, the most interesting to the general public was beri-beri. A paper on that disease was sent by Mr. Leonard Braddon. He maintains that "the cause of beri-beri is an 'intoxication,' which may be of every grade of destructiveness, from the imperceptible to the severest, the result of a peculiar and probably specific poison, contained so far as is at present known only in rice, or the products of its digestion, when consumed in a certain state—namely, when it has been exposed for some time, subsequent to decortication, so as to become stale." Mr. Braddon claims to have fully proved his case, though attempts to isolate the toxic principle from stale rice have not been successful. A variety of opinions was elicited. Colonel McGill quoted an example of beri-beri when there was no question of rice eating—namely, the cases of 61 British soldiers who had been attacked by the disease at Poona in a period of three months. Professor Musgrave suggested, as the result of experiments carried on at Manila, that the disease was due to some micro-organism, and Dr. Powell, of Bombay, objected to that theory, that if there were an organism a period of incubation might be expected, but there was no such period in beri-beri.

Leprosy.

Finally, mention must be made of the many papers dealing with the Nastin treatment of leprosy. The method by which Professor Deycke isolated the neutral fat that he has called Nastin was fully described in a communication from the professor, and the result of his work may be summed up, he says, in the following sentence:—"Benzoyl-Nastin is an agent which directly acts on leprosy bacilli. This sentence expresses—in comparison with other therapeutic efforts—the advantages and progress of the Nastin treatment of leprosy; on the other hand, however, it clearly points out the limitations of the treatment." He believes that this treatment of leprosy if resorted to without exaggerated expectations, will have satisfactory results, and will in many cases arrest the leprous process and even cause a retrogression of the leprous symptoms. The subject is not one on which generalization is yet possible, but the report by Captain Beauchamp Williams, Residency Surgeon in the Persian Gulf, on some cases he had treated by this method appeared to confirm Professor Deycke in his claims.

In this brief survey of the congress there is not space to describe the fine pathological exhibition that was organised for the occasion, nor to refer to many of the interesting papers, such as that by Professor Musgrave, of Manila, on mycetoma. But any notice would be incomplete that did not state that Major Smith.

of Jullundur, attended and read several papers on ophthalmic and other surgical operations. Major Smith's experience in the operation of extraction of cataract in the capsule now embraces nearly 20,000 cases, and he attracts to his hospital Afghans from Cabul and men from every part of India; his fame, as one speaker said, has all been obtained by a "knowledge of how to use a couple of blunt hooks in the extraction of cataract."

EAST INDIES.

No. 2.

CEYLON.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 6 July, 1909.)

MY LORD,

On Tour, Ceylon, 16 June, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of 31st March* on the subject of preventive measures adopted in Italy against the spread of malaria, and enquiring to what extent the same measures could be adopted in this Colony.

2. In reply, I have to inform you that the policy which is being carried out here to combat the causes and to prevent the propagation of malaria is on the same lines as those described by Dr. Osler in his letter to the "Times."

3. A full description of the measures taken to check malarial fever in Ceylon during the year 1908 is given in the accompanying copy of a report by the Principal Civil Medical Officer.

I have, &c.,

HUGH CLIFFORD,

Officer Administering the Government.

Enclosure in No. 2.

MEASURES TAKEN TO ERADICATE MALARIAL FEVER IN CEYLON DURING 1908.

In compliance with the instructions issued in the Secretary of State's circular dated March 12, 1909, I have the honour to submit a report on the anti-malarial measures carried out in Ceylon during the year 1908.

2. In my report on this subject for 1906 the rainfall and general configuration of this island were described; therefore it is unnecessary to make any remarks under these headings on this occasion.

3. The general principles for the prevention of malaria, namely (a) by educating the public as to its cause and prevention; (b) improvement in the sanitation of towns and villages; and (c) the distribution of quinine as a prophylactic, were continued throughout the year.

4. (a) *Education*.—The Provincial Surgeons on their tours of inspection, the medical officers of districts, and the apothecaries in charge of remote dispensaries, regularly gave popular lectures to the headmen in all parts of the island, and many thousands of the population attended these demonstrations.

Thousands of pamphlets describing the cause and prevention of this disease have been widely distributed in the English and local vernacular languages.

There was a special course of lectures delivered at the Ceylon Medical College to a large class of native school teachers on sanitation and hygiene, with special reference to the cause and prevention of malaria and the extermination of mosquitoes.

For the first time since these measures were started here many of the Provincial Surgeons report that the dissemination of this knowledge is having good results; that the prejudice against the modern and accepted cause and prevention of malaria among the native races is beginning to be broken down, and that they ask for quinine to be given them as a prophylactic.

5. (b) *Sanitation*.—There has been a marked improvement in the general sanitation of the small towns and villages. Many of them have been provided with good cement surface drains, brushwood has been cut down in the neighbourhood of

dwelling, hollows have been filled, and some canals have been dug for the draining of collections of water. Oiling the surface of large pools has been carried out in some instances.

The lines on which improved sanitation has proceeded have been confined to minor works; no large works on an expensive scale have been attempted, but His Excellency the Governor has included a large sum for such works in his future programme.

In May I submitted a letter to the Hon. the Colonial Secretary recommending the establishment of "Mosquito Brigades" in the following terms:—

With reference to the subject of malaria prevention and the extermination of mosquitoes, I have the honour to suggest that the Chairmen of the several Municipalities, Local Boards, &c., be communicated with, with the object of establishing "mosquito brigades" for the various towns.

The mosquito brigade consists of a head overseer and as many subordinates as are necessary for the work; the pay should be generous. It is necessary that the overseer be a man of high character and respectability, and that the whole "brigade" is honest and of good character. Its duty is to go into the compound of every house and collect all broken bottles, tins, broken flower pots, coconut shells, &c., and anything likely to contain water in which mosquitoes can breed; to look for the larvæ of mosquitoes in tanks, wells, cisterns, in the ends of bottles placed on dividing walls, &c., and to remove everything that is of no value and deposit it where hollows require filling up.

The "brigade" should, in addition to the above, empty all small collections of water, by the free use of a broom, and fill up the small hollows with earth or gravel.

Wells should be protected by a mosquito-proof cover with a wire gauze grating for the bucket.

The edges of streams and tanks near or in a town to be kept free from sedges and grass, and all rank vegetation which harbour mosquitoes should be cleared.

In Sierra Leone it was found that a gang of six men with one large mule cart were able to clear fifty houses daily and to remove ten cartloads of broken material and rubbish, *i.e.*, one cartload for every five houses. The medical officer in most of the towns is able to train the brigade as to their duties, and to point out the distinguishing features of the *Culex* and *Anopheles* mosquitoes and their larvæ and their likely breeding grounds.

This letter was sent by the Government to the Chairmen of each Local Board. Of the 24 replies, I regret to say that only three—Colombo, Galle, and Negombo—have promised to take any serious action towards exterminating mosquitoes. The reasons given by the others fall under two heads; (a) the Boards do not consider any action necessary, and (b) that no funds are available.

In my report to Government on these replies it was suggested that the extermination of the malarial mosquito in towns and villages should be made compulsory by law; subsequently I was directed to frame some draft regulations on the matter, which have been submitted for consideration.

The employment of prisoners where they are available for the carrying out of works for the extermination of the breeding places of the malarial mosquito has been suggested.

6. (c) *Quinine as a Prophylactic*.—Apothecaries, headmen, and others have been employed in distributing quinine gratis in all parts of the island, and large quantities of the drug have been expended. Returns as to the amount expended by each distributor have not been called for on the ground put forward by Professor Ronald Ross that "detailed returns cause much trouble which will result only in decrease of the issue." No records have been kept as to the incidence of the disease in those undergoing protective treatment by quinine, and those who did not take the prophylactic. The compulsory preventive treatment by quinine has been carried out in the schools and jails in malarious districts, with marked success. The sick-rate from malaria has been very low in the prisons, and the regular attendance of children in schools has not been seriously interrupted by outbreaks of malaria among them.

7. The amount of quinine issued for all purposes from the Medical Stores was 71,456 ounces.

8. Acting on the suggestion of Professor Ronald Ross in his "Report on the

Prevention of Malaria in Mauritius," orders were issued for a spleen-census to be taken, towards the end of 1908.

The subjects examined were the children in schools and young persons and children attending the dispensaries. As this is the first occasion on which such an inquiry has been made here, and some of the observers may not be quite familiar with enlarged spleens, and particularly into what category the enlargement should be put, and on account of the few number examined considering the population, some allowance for inaccuracy must be given to the figures and to the deductions drawn from them, but the results give an indication as to the amount of malaria in Ceylon. The total estimated population of children under 15 years of age for the island at the end of 1908 was 1,622,766; of this number, 92,258 were examined, and enlargement of the spleen was reported to be present in 31,421, a percentage of 34·05 as the "spleen-rate." There was no "enlargement" in 60,837. The "average spleen" works out at 2·14 for Ceylon children. The statistical errors in the above calculations have not been estimated.

The accompanying table gives the numbers examined, the total enlarged spleens, the sizes of enlargement, the spleen-rate, and average spleen by Provinces; and the figures support the observations that have been made for years as to those Provinces which have always borne a reputation for a large amount of malaria :—

Province.	No. Examined.	Total Enlarge- ment	Enlargement of Spleen.			Spleen Rate.	Average Spleen.
			Small.	Medium.	Great.		
Northern	11,371	4,538	2,567	1,194	777	39·91	2·52
Southern	15,022	2,847	1,794	600	453	18·95	1·67
Eastern	6,476	2,266	1,449	572	245	34·99	2·19
North-Western ...	17,024	9,064	4,675	2,975	1,414	53·25	3·08
North-Central ...	5,087	3,215	1,491	1,100	624	63·20	3·61
Uva	5,177	2,291	1,088	686	517	44·25	2·88
Sabaragamuwa ...	7,154	2,046	1,049	527	470	28·60	2·18
Central	14,362	2,804	1,631	817	356	19·52	1·70
Western	10,585	2,350	1,867	417	66	22·20	1·59
Total	92,258	31,421	17,611	8,888	4,922	34·05	2·29

May, 1909.

ALLAN PERRY.

No. 3.

MAURITIUS.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 24 July, 1909.)

MY LORD,

Government House, Port Louis, 21st June, 1909.

WITH reference to your Lordship's despatch, Circular, of the 31st March last,* I have the honour to transmit herewith a copy of a report by the Acting Medical Director showing that the policy pursued in Italy to combat malaria has already, and as far as possible, been adopted in this Colony.

2. Dr. Barbeau has referred to the cause which renders a more extensive campaign and larger measures of prevention impracticable at the present time, namely, the lack of means.

3. With regard to the recommendation of Professor Ross, I have to endorse the Medical Director's report, and to state that, as far as possible with the limited means available, every endeavour is being made to give effect to them.

4. In this connection, however, I have in view the position indicated in the enclosures in your Lordship's despatch of the 27th April last,† and I append copies of a letter from the Mayor of Port Louis, and the reply which has been sent to him, with regard to the commencement of extensive anti-malarial works in that town.

I have, &c.,

CAVENDISH BOYLE.

Enclosure 1 in No. 3.

DIRECTOR, Medical and Health Department, to COLONIAL SECRETARY.

(No. 818.)

5th June, 1909.

ADVERTING to despatch, Circular, 31/3/09, and accompanying copy of a Circular despatch from the Secretary of State, I have the honour to state that the policy adopted in Italy has been successfully pursued in this Colony for several years past so far as the resources of the Health Department have permitted. These resources having, unfortunately, always been limited, the work done has, of necessity, been confined to individual buildings or small areas, and the results, though satisfactory in themselves, have had but little effect on the general death-rate of the island. Previous to Professor Ross's visit certain Government buildings had already, as you are aware, been protected against mosquitoes by wire gauze screens, to wit: the Royal Alfred Observatory, the hospital wards of the N. C. prisons at Beau Bassin, the plague hospital at Lower Plaines Wilhems, &c. Various major and minor works had been undertaken to combat malaria at Moka, Pamplemousses, and specially at Phoenix (Clairfond); quinine had been distributed free to the poor, and at a nominal price to those able and willing to pay for the drug, from 28 dispensaries and 36 quinine dépôts located in the more malarious portions of the island; in addition to this, itinerant dispensers had been employed on occasion arising to supply the sick with free medicines at Pointe aux Piments, Grand Bois, Phoenix.

It will perhaps not be out of place to state here in some detail what has been done on the same lines since Professor Ross's report has been received. From want of funds mechanical protection has not been extended to other buildings, but

- (1) With the kind assistance of the Education Department the school children throughout the Colony are periodically examined by the medical officers of this Department, and quinine is issued free to the school teachers for the treatment of those found with an enlarged spleen.
- (2) Efforts have been, and are being, made, with the co-operation of the Immigration Department, to secure a similar treatment for the children on the sugar estates, and to ensure that labourers affected with malaria should be submitted to a continuous course of the drug.
- (3) A house-to-house spleen census is being made at Port Louis by three of the medical officers attached to this office, who take advantage of the opportunities thus afforded them to distribute quinine free of charge to all persons requiring and willing to take it.
- (4) A house to-house distribution of quinine is also being made in the extra-urban area of Port Louis by the dispenser in charge of the G.R.N. West plague Lazaret.
- (5) Government servants receiving less than Rs. 720 per annum are supplied with the drug free of charge on applying at a hospital or dispensary, or through the head of their Department.
- (6) Minor works are being carried out in extra-urban Port Louis by two moustiquiers and four malaria gangs of three labourers each; in the other districts by the moustiquiers and gangs under Mr. D. Emmerez, by the sanitary bands of Mahebourg, Souillac, and Rose Belle, and by prison labour in the rivers of Plaines Wilhems, Pamplemousses, and Flacq, while such preliminary work as could be undertaken has been commenced for the drainage of the swamps at La Louise and the Curepipe Marshes.
- (7) Major works are being carried out under the supervision of the Sanitary Engineer at Pamplemousses and centre of Flacq.

Professor Ross having expressed himself (p. 108 of his report) as rather against the use of quinine chocolates and such like, and having recommended the distribution of the drug in the form of freshly made pills, this method has been adopted in preference. After some time an improvement has been introduced which consists in issuing the quinine from the medical stores in the form of tabloids or pellets enrobed in finely powdered magnesia. By means of a simple contrivance 1,000 of these pellets can be turned out per hour, thus permitting of the vastly-increased demands upon the stores being met without any increase in the staff.

In reply to the query contained in the 2nd paragraph of the Secretary of State's circular, it may, therefore, be stated that the policy that is represented as having

been successful in Italy can be, and as a matter of fact has already been, adopted in this Colony.

L. G. BARBEAU,
Acting Director.

Enclosure 2 in No. 3.

(No. AF/749.)

Mauritius, Municipality of Port Louis, Town Hall,

SIR, 1st June, 1909.
I AM commissioned by the Municipal Council to transmit to you the following resolution which was unanimously passed at their sitting held yesterday:—

“The Municipal Council is deeply moved by that part of His Excellency’s opening speech at the first sitting of the Council of Government where His Excellency contemplates the possibility of deferring, for the present, the expenditure on anti-malarial works and begs most respectfully to urge upon His Excellency and the Government the necessity of beginning without delay anti-malarial works in the districts surrounding the town of Port Louis.”

I have, &c.,
E. LAURENT,
Mayor of Port Louis.

The Honourable
The Colonial Secretary.

Enclosure 3 in No.

SIR, Colonial Secretary’s Office, Mauritius, 21st June, 1909.
IN continuation of my letter, No. 5027/09, of the 5th of June, I am directed by the Governor to inform you that His Excellency, in his speech to the Council of Government at the opening of the present session, purposely refrained from making any reference to the postponement of expenditure on anti-malarial works beyond saying that it might be possible to defer the capital expenditure on such works for a time, as was stated in the report of Major Ross.

2. I am to add that, pending the completion of the enquiry by the Commissioners whom His Majesty has been pleased to appoint, it will not be possible to entertain any proposal which involves capital expenditure as indicated to be necessary by the Municipal Council of Port Louis.

I am, &c.,
J. MIDDLETON,
Assistant Colonial Secretary.

His Worship the
Mayor of Port Louis.

EAST AND WEST AFRICA.

No. 4.

EAST AFRICA PROTECTORATE.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received June 12, 1909.)

MY LORD, Governor’s Office, Nairobi, May 3, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship’s circular despatch of March 31st,* respecting the measures taken to combat malaria in Italy.

2. A Memorandum by the Principal Medical Officer on the application of Dr. Osler’s proposals to this Protectorate is enclosed herewith.

3. Your Lordship will perceive that it is thought that in Mombasa only, and

there to a limited extent, would it be practicable to introduce the suggested policy of malarial prophylaxis.

I have, &c.,
F. J. JACKSON.

Enclosure in No. 4.

MEMORANDUM.

The policy of the free distribution of quinine throughout the country would be almost an impracticable scheme owing to the difficulty of carrying it out. On his own initiative the average native is incapable of understanding the necessity of systematic treatment and continued dosage. With a superstitious belief in the efficacy of the white man's medicine, in nine cases of ten if left to himself, a single dose is all that he considers necessary to perform miracles. A propaganda throughout the malarious districts of the country of free administration of quinine, if imposed on all the various staffs, would involve an expenditure of time to the exclusion of all other duties.

So far the distribution of quinine has been limited to its administration to suitable cases coming up for treatment in the Government dispensaries. All cases of the native inhabitants presenting themselves have free treatment and dosage.

I think the measure could be imposed with a certain amount of success on the town of Mombasa. Only, as Professor Ross points out, it must be combined with mosquito destruction, and for this a Mosquito Ordinance would be necessary. Otherwise the continued presence of breeding puddles will militate largely against the success of the scheme, and the sanitary and conservancy staff of the town is so hopelessly inadequate that it can but barely overtake the grosser cleansing of the town leaving the more scientific issues untouched.

A. D. MILNE,
Principal Medical Officer.

Nairobi,
May 1, 1909.

No. 5.

EAST AFRICA PROTECTORATE.

ANNUAL REPORT OF THE PRINCIPAL MEDICAL OFFICER, NAIROBI,
31st MAY, 1909.

(Received 14 August, 1909.)

(Extract.)

MEASURES DIRECTED TOWARDS THE ERADICATION OF MALARIAL FEVER AND OTHER
MOSQUITO-BORNE DISEASES.

(a.) *Clearing Bush and Rank Vegetation.*—It must be remembered that the vast majority of towns and stations in the country are not ten years old, and that every year sees one or more new stations opened up; that there is, consequently, an enormous amount of work to be done in this respect. It is satisfactory to report that each year sees an improvement under this heading. The chief agencies by which this is effected are, in order of importance, as follows:—The Railway Department, with its special gangs of maintenance labourers and funds, is in a position to devote a good deal of care to keeping down vegetation in the neighbourhood of its various locations: notably at Kilindini, Voi, Makindu, and Kisumu. The Public Works incidentally do a good deal in the course of constructing new roads, the erection of new buildings, and the laying out of drains. There are, besides these two factors, the efforts of those in authority all over the country, who have used prison labour, station hands, and safari porters on works of clearance and public amenity. Of special efforts in this direction the town of Kisumu carried through the clearance of a quarter-mile wide strip of land surrounding the township. Though primarily undertaken as a defensive measure against plague, the benefits of this operation will be equally felt in the destruction of possible mosquito harbourages. In addition, the uprooting of scrub and clearances for the formation of the Connaught Parade were pushed on. A sum of £200 was allowed for these works.

(b.) *Drainage*.—Each successive year sees an advance in this direction; the formation of new earth trenches, and the conversion of old ones into stone or cement drains and culverts. In Nairobi, under the Williams' scheme of sanitation, a sum approximating £10,000 has, up to date, been spent on cement drains and flushing mains in connection with them. The benefits of all this will not be felt until the whole scheme has been connected up.

(c.) *Improvements on Swamps and Water Holes*.—The Railway Department and the Public Works Department are the two worst offenders in the formation of borrow pits. There is a chain of such pits either side of the railway from Mombasa to Kisumu, left by the construction of the railway, for which it can only be said that the vast majority are situated in uninhabited land. Of those in the vicinity of the stations an effort has been made to either drain them or fill them up. As regards the Public Works Department, whose labours so closely affect the surroundings of human inhabitations, it is noteworthy that a more scientific method of excavating the necessary gravel pits has been adopted; a method which ensures natural drainage, and does away with the need of filling up the pit afterwards. This consists in marking out a square area on a slope, and removing the material so as to leave a wedge-shaped depression in the ground. As the base of this wedge is up-hill, and as there is no lip to where it fines off down-hill, rain-water or surface washings that fall into the pit instantly run off.

Of swamp improvements the work begun the previous year in connection with the Connaught Parade—the reclamation of the foreshore of the Victoria Nyanza at Kisumu—was continued, with one or two interruptions, during the year. Up to date the length of over a mile, varying from 30 to 60 yards wide, has been filled in and levelled—where was once the haunt of innumerable breeding places of mosquitos. There now only remains to complete the scheme about a quarter of a mile; the importance of it can hardly be overestimated.

(d.) *Application of Petroleum*.—Very little has been done in this direction. At Kisumu repeated oilings were applied to pestiferous pools until the work of filling them in was undertaken.

(e.) *Mosquito-proof Wire Gauze Fittings*.—Most of the houses at the Coast and Kisumu are provided with wire gauze window frames and doors. In a tropical country it seems almost impossible to have frames made that do not warp. On the Coast, owing to the sea-laden breezes, there is a special tendency for the gauze to rot. It is a great pity that so few of the planters on the littoral make use of this means of protection.

(f.) The prophylactic administration of quinine is nowhere carried out systematically. To do so in the districts where it would be advisable to introduce it would require a supervisory staff, which it would be impossible to obtain.

(g.) No legislative measures were introduced during the year, but the consideration of a Mosquito Ordinance, applicable more particularly to Mombasa, has only been deferred pending the education of public opinion. In this town propagandist measures have been begun—and in no other town is it so much needed. An intelligent Arab was detailed to visit in the native quarter, and instruct the house and hut-holders there on the necessity of frequently examining their water-barrels and earthen vessels, to empty out receptacles containing mosquito larvæ, and to point out the danger of allowing collections of stagnant water to lie around the houses.

(h.) *The Cost of Anti-Malarial Measures*.—No special sum was included in the year's estimates for this purpose, but as already stated the cost of works which directly bear on this question amounted to £200 at Kisumu, and £4,000 spent on drainage at Nairobi. Statistics relating to any of the above measures are not available.

No. 6.

EAST AFRICA PROTECTORATE.

REPORT BY DR. J. A. HARAN, M.D., MEDICAL OFFICER OF HEALTH,
MOMBASA, 1908.

(Received 14 August, 1909.)

(Extract.)

10. *Anti-mosquito Measures*.—The inhabitants of the native town store their water in earthen vessels and wooden barrels. The latter are usually outside the

houses. In addition, the better class provide themselves with open cement tanks in connection with their cesspools, all under the dwelling roof. Needless to say larvæ are to be found abundantly in all these receptacles. Within the last six weeks an intelligent Arab has been detailed by the Liwali for house to house visitation, his purpose being to see that water vessels are periodically cleansed, that collections of foul water are thrown out, and that barrels of water which contain larvæ are dealt with by filtration and subsequent sealing. He has been assiduous in his work, and, apparently, is meeting with the co-operation of the Arabs and Swahilis of the town. House to house visitation will, of course, be a permanent institution.

No. 7.

NYASALAND PROTECTORATE.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 3 July, 1909.)

Government House, Zomba, Nyasaland Protectorate,

MY LORD,

22nd May, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of the 31st of March, 1909,* on the subject of malaria prophylaxis in Italy.

2. I transmit a copy of a memorandum prepared by the Principal Medical Officer, dealing with the question of the extent to which the means employed in Italy can be adopted in Nyasaland.

3. I would add that in the *larger* European settlements in this Protectorate, malarial complaints are fortunately less frequent than in the smaller outlying stations, and a certain amount of mosquito work can be and is being done in these settlements; but in the case of the great bulk of the Protectorate, occupied by scattered native villages, little can be accomplished.

I have, &c.,

ALFRED SHARPE,

Governor.

Enclosure in No. 7.

MEMORANDUM.

Of the endemic diseases of Nyasaland, malaria unquestionably occupies the foremost place by reason of its extremely wide range of distribution and the morbidity to which it gives rise.

Blood examinations of native children, tentatively made, have disclosed the fact that only a small proportion probably escape infection, and anophelines being everywhere abundant, these reservoirs of the malarial plasmodium must remain a never-ceasing menace to the public health.

The various measures which have been advocated for combating malaria, namely, mosquito destruction, by Ross, segregation, by Stephens and Christophers, quinine prophylaxis, by the Italian school—all these can be, and have been, applied in townships and other European settlements, and it may unhesitatingly be said, with marked success.

As regards the general population, on the other hand, the conditions are widely different. Natives of Nyasaland are engaged almost exclusively in agriculture, but the idea of irrigation appears not to have occurred to them. They are accordingly settled in close proximity to lakes, rivers, streams, pools, and marshes generally, in order to obtain the requisite moisture for their crops. They are, moreover, dependent on these sources for their water supply, as wells are unknown to them.

Amidst such surroundings all the conditions favourable for the development and dissemination of the malarial plasmodium are abundantly present—mosquitoes, water for these insects to breed in, and successive generations of children in whom the parasite can pass its intra-corporeal phase of existence.

Under these circumstances quinine prophylaxis is the only measure which could

* No. 1.

be applied to the native population with any chance of success, for it would obviously be impossible to remove them from their fever-haunted surroundings. Natives as a rule have considerable faith in European remedies, and after due explanation could be got to understand the value of quinine in malaria. But the distribution of quinine would have to be gratuitous if it was desired to place the remedy within the reach of all, and here the question of expenditure would have to be considered. A beginning could, however, be made in the case of natives resident in the immediate vicinity of European settlements, and opportunity would also be afforded for noting the result of this prophylactic measure.

H. HEARSEY,
Principal Medical Officer.

13th May, 1909.

No. 8.

NYASALAND PROTECTORATE.

MEDICAL REPORT ON THE HEALTH AND SANITARY CONDITION OF THE NYASALAND PROTECTORATE FOR THE YEAR 1908-9.

(Received July 3, 1909.)

(Extract.)

ANTI-MALARIAL MEASURES.

These may, for convenience, be enumerated under the following headings:—

1. *Measures which may be said to be in general application:—*

- (a) The clearing of all brushwood and rank vegetation in and around European settlements.
- (b) Drainage wherever this is practicable.
- (c) Filling up of hollows and depressions where water is likely to collect and stagnate.
- (d) The segregation of natives in what are termed native locations, at a distance from dwellings of Europeans. Great importance is attached to this measure in view of the high percentage of malignant tertian infections in native children.

2. *Measures which are more or less in general application:—*

- (a) The taking of quinine as a prophylactic. This practice is almost the rule at stations on the lake and river level, but it is far from general at the higher elevations where mosquitoes are not necessarily non-existent.
- (b) The use of mosquito-nets.

3. *Measures which are not in employment, but the expediency of which is generally recognised:—*

- (a) Making houses partly or wholly mosquito-proof with wire gauze netting.

The adoption of such a course at stations such as Port Herald, Chiromo, Liwonde, and Fort Johnston on the river, and Kota Kota and Karonga on the lake, would, no doubt, appreciably diminish the incidence of malarial fevers at these settlements. The experiment would well be worth submitting to a trial at Port Herald and Chiromo, for instance, the abnormally high mortality at which has already been alluded to. But in order to put this experiment to a fair trial two points are essential: firstly, there should be no flaw in the fittings supporting the wire netting; and secondly, all the houses without exception should be so protected, otherwise the occupants of the unprotected houses would infect the others. It is sometimes objected that mosquito-proof houses are "stuffy," but if punkahs are used, when necessary, this objection should carry no weight.

- (b) The quininisation of the native population in the neighbourhood of European settlements, more particularly of infants and children.

4. *Measures which are advocated and put into effect in some Colonies, but which, by reason of their cost, would be prohibitive in this Protectorate:—*

- (a) Draining of marshes.
- (b) Filling up of swamps.
- (c) Application of paraffin oil on an extensive scale. Marshes such as those which surround Port Herald, Chiromo, Kota Kota, Karonga, would

be difficult or even impossible to deal with, and the only course which suggests itself in these instances is to remove the settlements wherever this is practicable.

May 31, 1909.

No. 9.

SOMALILAND PROTECTORATE.

THE COMMISSIONER to THE SECRETARY OF STATE.

(Received 8 May, 1909.)

MY LORD,

Commissioner's Office, Berbera, 19th April, 1909.

WITH reference to your Lordship's Circular Despatch of the 31st March,* I have the honour to transmit the accompanying copy of a letter from the Senior Medical Officer of this Protectorate.

I have, &c.,

H. E. S. CORDEAUX.

Enclosure in No. 9.

SIR,

Berbera, April 15th, 1909.

I HAVE the honour to report that I have read the attached circular report on the subject of "Malaria in Italy," by Dr. Osler, and the other reports.

The policy which Dr. Osler represents is of the highest character—in fact the very best known. I am in entire accord with all the suggestions made in this report, and have much pleasure in informing you that under a system of careful supervision to prevent waste, I have this year been able for the first time to introduce tannate of quinine, in convenient tabloid form, into the Estimates, without unduly impoverishing the Departmental Vote.

Enormous expense must be incurred in clearing any large area of mosquitoes unless those doing so effect the purpose for agricultural purposes and are free from malarial fever.

I have, &c.,

A. J. M. PAGET,

Senior Medical Officer.

His Majesty's Commissioner.

No. 10.

SOMALILAND PROTECTORATE.

SUPPLEMENTARY REPORT ON MALARIAL PROPHYLAXIS BY
DR. A. J. M. PAGET, SENIOR MEDICAL OFFICER, SOMALILAND.

(Received in Colonial Office, May 8, 1909.)

During the year I have great pleasure in reporting that the measures enforced have resulted in a considerable diminution of the total number of malarial cases as compared with last year.

There has been a reduction by one-third practically on last year's total, during the twelve months; and there is every reason to predict that this reduction will continue still further.

The measures which have been employed to bring about this result are as follows:—

- (1) Educational.
- (2) Improved organization regulations.
- (3) Improvements in sanitation.
- (4) Quinine, as treatment, and as a prophylactic.

(1) *Educational*.—The hospital assistants and compounders have been carefully taken over the subject: mistaken knowledge corrected, and all material facts been verified in their proper acquaintance with the subject. Attention has been especially

directed to their having a lucid conception of the malarial cycle of events and changes. When satisfied that benefit could result from their knowledge being sufficiently accurate, they have been directed to approach all the better-informed natives that come within their acquaintance, or that they are brought in contact with, and interest them. By answering the questions asked, I am convinced that more knowledge can be diffused than by merely giving an exposition on the subject, which is always liable to be over the heads of, or to pall, the listeners, whose interest at once ceases. The method I regard as a slow but particularly sure one for Somalis.

(2) *Improved Organisation Regulations.*—As in all other tropical countries, it has been found greatly to mitigate disease to have the European and native population separated—to have the towns, European and native, always at a distance from one another. This has been done more completely than formerly, by bringing the Europeans formerly stationed in the native town to quarters in the European.

Stricter measures have been enforced to investigate all cases of sickness among the prisoners in the jail. Attention has been given to seeing that they actually take the medicine given them, and that malingerers are reported to the proper authority.

The most important advance of all has, however, been made in the control instituted over the official subordinates; these in the past were accustomed to report themselves sick at their offices, but frequently to neglect all treatment of their condition; or in some cases to use sickness as an excuse for a holiday, often lasting four or five days. This has now met with a considerable check. The names of all sick subordinates are sent to the head of each Department daily; and in their treatment they are given their medicine as far as possible at the dispensary, and seen to take it. Those who are more than merely indisposed for a day or so, are made to come into hospital as in-patients, where they are given their medicine, instead of being allowed to take it or not as they may feel inclined. The result of this change has resulted in an enormous total reduction in the number of days of sickness from malaria among the subordinates.

The measure of being forced into hospital, and having to take medicine, or run the risk of being discharged, is, of course, highly unpopular, especially among the Indian subordinates. Complaints about everything imaginable in connection with the hospital management were made at first, and received all attention where genuine. The hospital does not provide, however, that luxury of mild malarial patients, namely, a holiday, with an enviously sympathetic audience, and can never compete with the former system in popularity. The enforcement of the regulation has been in fact one wearing combat against almost imaginary complaints, and attempts on one's credulity. The result has, however, brought out facts and lessened the duration and number of malarial patients.

(3) *Improvements in Sanitation.*—The Public Works Department have done considerable work, though hampered for want of further funds. Progress has been made along intelligent lines. Attention has been given to the supervision of the work of regularly cleaning out the Government water tanks, and the prevention of water waste.

Owing to the sandstorms and dryness of the climate no trouble is experienced with borrow pits as in the case of East Africa. Such quarries or pits as exist are rapidly filled by the sand, and are usually perfectly dry.

(4) *Quinine as Treatment and as a Prophylactic.*—Comparatively little trouble is experienced except among the Indian subordinate class in persuading those afflicted as to the benefit to be derived by the use of the drug. What trouble there is usually is determined by the patients' lack of appreciation of the malarial cycle, and the importance of taking the drug at the best time to accomplish the death of the plasmodium. The prophylactic treatment has to a great extent been responsible for this fact being overlooked when a sharp attack happens to attack many persons. Comparatively few persons take quinine in the correct prophylactic method, though results would warrant its full encouragement.

Quinine has been made accessible to all natives applying at any of the civil or military hospitals in the Protectorate, as well as at some of the political outposts, and is as a rule highly valued and appreciated.

A. J. M. PAGET, M.D., &c.,

Senior Medical Officer, Somaliland.

No. 11.

UGANDA.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 5 August, 1909.)

MY LORD,

Government House, Uganda, 2nd July, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's Circular despatch of the 31st March last,* together with the two enclosures contained therein.

2. In reply to your Lordship's request to be informed to what extent the policy which is represented by Dr. Osler as having been so successful in combating malaria fever in Italy could be adopted in the Uganda Protectorate, the matter was referred to the Principal Medical Officer, and I enclose a copy of a letter on the subject which has been received from him.

I have, &c.,

STANLEY C. TOMKINS,

Acting Governor.

Enclosure in No. 11.

SIR,

Principal Medical Officer's Office, Entebbe, 29th June, 1909.

I HAVE the honour to forward herewith my remarks on the subject of the application of the preventive measures against malaria used in Italy to the case of Uganda Protectorate.

It appears to me that the main question raised is that of the enforced general prophylactic use of quinine.

I do not think that such a measure would be practicable in this country in the case of the native population, though small bodies of natives can be, and are, dealt with in this manner when it is considered necessary, and the Indian contingent of the 4th King's African Rifles has been so dealt with for several years with fairly satisfactory results.

In the case of the European population I do not consider that such a measure is generally necessary, though in the more malarial stations, such as those in the Nile Province, it is medically recommended, and as a rule carried out by European officials.

I consider that the attention to the general hygiene of stations and to the effective protection of houses against mosquitoes is more practical and more important.

I have, &c.,

A. D. P. HODGES,

Principal Medical Officer,
Uganda.

To the Chief Secretary,
Entebbe.

No. 12.

GAMBIA.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 31 May, 1909.)

MY LORD,

Government House, Bathurst, Gambia, 9th May, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's despatch (Circular) of the 31st March last,* covering a letter addressed to "The Times" of the 15th March, on the subject of "Malaria in Italy; a lesson in practical Hygiene."

2. With regard to the second paragraph of this despatch, I transmit a copy of a Report by the Senior Medical Officer, in which he states the steps already taken for the prevention of malaria in this Colony, and advocates the distribution of quinine generally in Bathurst, as far as is found possible.

3. I propose to adopt his suggestion with regard to the distribution of quinine

in Bathurst, and I beg to ask your Lordship to approve of the estimated expenditure of £50 that will have to be incurred on it.

4. It will, I fear, be rather a difficult matter to persuade the Bathurst people to accept the quinine, but it will be still harder task to get it taken in the Protectorate, and I think that the only thing that can be done in this direction at present is to consult the Commissioners and obtain their views on the point. This I shall at once do, and I hope to report further on the subject to your Lordship at an early date.

I have, &c.,
 GEORGE C. DENTON,
 Governor.

Enclosure in No. 12.

SENIOR MEDICAL OFFICER to the HONOURABLE COLONIAL SECRETARY.

The success in combating malaria in the Gambia is due practically to the measures advocated by the Italian Society, viz.:—

1. "Mechanical measures," *i.e.*, defence of the individual from the bites of the mosquitoes.
2. "Anti-plasmodic prophylaxis," the administration of quinine.
3. "Agricultural and agrarian transformation of the land," is, I take it, in reference to large tracts of country, and does not obtain in the Gambia.

Professor Osler's great point is the free distribution of quinine in as palatable a form as possible, and I think something might be done in this direction in the Colony.

1. Aborigines prefer to take their native decoctions when suffering from fever, and it is a difficult matter to persuade this class of folk to take quinine unless they visit the hospital.

2. All school children could be given quinine regularly if the school managers would co-operate.

3. All native officials might be asked to administer quinine to their families and households.

4. The Board of Health Inspectors could distribute quinine in the town in addition to their ordinary duties.

Quinine powder costs 1s. 3d. an ounce, and this, roughly, equals 100 5-grain doses, and should it be generously and freely administered—say, a 1,000 doses a week—the expense, including acid to dissolve the quinine and other charges, might reach £50 a year for Bathurst.

At present, I don't think it would be worth while attempting anything in the Protectorate in regard to the free distribution of quinine, but I am not really qualified to express an opinion on this.

T. H.

1 May, 1909.

No. 13.

GAMBIA.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 31 May, 1909.)

MY LORD, Government House, Bathurst, Gambia, 12th May, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of the 12th March last.*

2. Your Lordship's instructions with regard to fuller reports on anti-malarial measures have been communicated to the Senior Medical Officer, and in future cases Dr. Hood promises that they shall be observed.

3. As I thought it might be of interest to your Lordship, I called for a special report on the anti-malarial measures adopted here, and I now forward a copy of it as sent in by Dr. Hood, and may say that I propose to adopt the suggestion of a free distribution of quinine to the school children in Bathurst.

* Not printed.

4. I have also instructed the Legal Assistant to prepare a Public Health Ordinance bringing the local enactment of 1897 up to date with the law on sanitary matters as it stands in other West African Colonies.

I have, &c.,
GEORGE C. DENTON,
Governor.

Enclosure in No. 13.

REPORT ON ANTI-MALARIAL MEASURES, BATHURST.

1. *Removal of mosquito-breeding receptacles.*

There is little to add to previous reports. As hitherto, the sanitary staff directs special attention to the filling up of depressions and the removal of old tins and bottles, &c., capable of holding water, and during the year 1908 nearly 1,000 cart-loads of tins, bottles, and other rubbish were removed from the town, but it should be pointed out that a Bathurst Board of Health cart is a small thing compared to an ordinary English dust cart, the proportion being about 1 to 6.

The law dealing with sanitation does not include a section making it a punishable offence to have mosquito larvæ in the yard, and most of the occupiers of premises in Bathurst possess either a badly-constructed well or cesspit, or both; the lack of such a section in the Ordinance is responsible for many mosquitoes that might otherwise be avoided.

2. *Surface drainage.*

The existing drains in Bathurst are very defective, and towards the sluice gates most of them contain a considerable quantity of water, even in the dry season.

Special attention has been given to these drains throughout the year, for they have been well swept out once a week and oiled or treated with saprol so that the chance of any larvæ maturing in them has been reduced to a minimum.

In the rainy season a fairly large portion of the town is, for lengthy periods, under water, and in these extensive pools mosquitoes develop, and so long as this low-lying ground is left as it is mosquitoes will always abound.

Unfortunately again, Bathurst is in close proximity, all along one side of it, to a large swamp, and I have little doubt that many of the mosquitoes found in the town are brought in from this swamp by the prevailing breeze.

To fill in the low-lying portion of the town is practicable, although costly, and would be highly appreciated by the inhabitants apart from the point of view of the prevention of malaria; but the swamp appears to be an insuperable difficulty, and in consequence the extermination of mosquitoes in the town is a hopeless task. One can only aim at the reduction in their numbers.

3. *Mosquito nets.*

The use of the mosquito net is becoming more universal, and I have not yet seen or heard of a European living in the Gambia who is not provided with a mosquito-proof house or net to sleep in. I examine the nets of Europeans on every possible occasion, and I regret to say it is seldom that I do not find some fault, and it amazes me that there should exist any carelessness on the part of the occupier to patch up at once any holes through which mosquitoes can enter, not only for the sake of comfort, but to obviate the danger of infection.

A new mosquito house made of brass wire netting (mesh, 16 to the inch) has been introduced, and it is hoped this will prove more durable and less liable to injury than the cotton material now in use.

It is desirable that mosquito-proof enclosures should be extended to living rooms, as it is almost impossible for any one to sit down quietly during the day time without being annoyed by mosquito bites. It would be very expensive to render the ordinary house of a European in Bathurst mosquito proof, particularly as servants are constantly going in and out, which would spoil its efficiency, even with the exercise of great care.

The use of mosquito nets is becoming more and more recognised by the better-class natives and by the many Syrians living in Bathurst, but as a rule these nets are badly constructed and made of the wrong material.

The best mosquito net tends to interfere with the circulation of the air round

a bed, and unless the bed is well placed and the net is of ample size and made of proper material, even natives in the hot season find it intolerable. At present very few natives or Syrians have exhibited much intelligence in this respect, for many are still sceptical and regard an attack of malarial fever with little concern, and they do not seem to realize the importance of protecting children from mosquitoes in the early days of infancy.

4. *Quinine.*

The use of quinine as a prophylactic is extending, and its advantages are becoming known and in fact are known to every European and to every intelligent native. It would be very useful to administer it at regular intervals to children attending school.

5. *Instruction in hygiene and sanitation.*

Elementary hygiene and sanitation is a subject that has been introduced into the curriculum of teachers in the public schools, and their promotion to higher grades depends in part with their proficiency in this subject.

Two systematic courses of lectures have been delivered to teachers during the year; the results so far have not been very encouraging, although two teachers passed a very good examination and obtained prizes and certificates to teach this subject. The subject is a new one, and I do not regard seriously this initial apathy to take it up.

6. *General remarks.*

From general report and personal observation I gather that mosquitoes were more abundant in 1908 than for some years previously. In places I found the walls black with them, and I was particularly struck with the apparent small percentage of anopheles amongst them. Of a collection sent to Professor Nuttall at Cambridge and identified by Mr. F. V. Theobald, the following report was furnished:—

24 *Stegomyia fasciata*.
 9 *Culex fatigans*.
 34 will be reported on later.
 —
 67
 —

I am quite satisfied that the staff of the Board of Health performed their work well, because I personally superintended a great deal of it, and I can only account for this increase in the number of mosquitoes by the cutting down of the mangrove trees over a large area of swamp land at the back of the town.

The large proportion of other mosquitoes to anopheles accounts for no perceptible increase in the number of cases of malaria treated during the year, and I am glad to state that there was no case of yellow fever in the Gambia during this period.

T. Hood,
 Senior Medical Officer.

Medical Office, Gambia,
 26th April, 1909.

No. 14.

GOLD COAST.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 9 June, 1909.)

MY LORD, Government House, Accra, 20th May, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch, of the 31st March last,* transmitting a copy of the very instructive letter, dated the 3rd idem, addressed by Dr. W. Osler to the Editor of the "Times."

2. I attach an extract from a minute by the Principal Medical Officer (Dr. W. H. Langley), to whom this correspondence was referred.

3. In the course of several years' service in tropical countries I have seen nothing which induces me to question Dr. Osler's conclusion that the right means of fighting malaria are the defence of the habitation and the individual from the bites of infected mosquitoes. Personally, I do not advocate the adoption of extensive measures for the extermination of mosquitoes, and I believe that the solution of the problem lies in improved sanitation and drainage, the administration of quinine, segregation, and the protection of the individual from the bites of mosquitoes by the use of mosquito nets or wire-gauze sleeping rooms.

As your Lordship is aware, extensive schemes for the drainage and the sanitary improvement of most of the principal towns in the Colony have been formulated, and in many cases are in active progress. The periodical use of quinine is prescribed for all European officials. Segregation has been carried out at Accra; the principle is carefully kept in view in laying out new townships, and adopted, as opportunities occur, in re-modelling the older residential areas occupied by a mixed population.

4. With reference to the suggestion put forward by the Principal Medical Officer in paragraph 4 of his minute, I do not think, from my experience here, that it would be found difficult to induce children to take quinine if the drug could be made up in an attractive form as is done by the Italian Society for the Study of Malaria, and I shall be glad to be furnished with particulars as to the cost of these special preparations and the names of the manufacturers from whom they can be obtained.

5. In order to determine the value of the experiment suggested by the Principal Medical Officer, it would appear to be necessary to distribute the prophylactic doses to children attending a particular school (say, the Government Boys' School at Accra), and to compare the number of malaria cases after a certain period with those in another school in which no distribution has been made. I propose, further, to consult the Principal Medical Officer on this point before authorising a gratuitous distribution of quinine.

I have, &c.,
H. BRYAN,
Acting Governor

Enclosure in No.14.

EXTRACT FROM A MINUTE BY THE PRINCIPAL MEDICAL OFFICER.

HONOURABLE COLONIAL SECRETARY,

* * * * *

2. His Excellency's minute of 19th April. I am not sure that the methods referred to by Dr. Osler would be easily applicable to West Africa generally. Italy is a civilised country, and West Africa can hardly yet be described as other than a more or less savage one; and the people whom it would be most desirable to reach with quinine prophylaxis are the most difficult to get in touch with.

3. I am more optimistic than Dr. Osler as to the possibilities of mosquito extermination, and these possibilities will increase step by step with improvements in sanitation.

4. If we can induce the people to take quinine and give it to their children, it would be of great benefit. The experiment might first be tried in Accra and, if found successful, adopted generally. Will His Excellency authorise a gratuitous issue of quinine, and, if so, can notice be published? It will be necessary to indent for a large supply.

W. H. L.,
Principal Medical Officer.

6 May, 1909.

No. 15.

SIERRA LEONE.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 25 May, 1909.)

MY LORD, Government House, Freetown, Sierra Leone, 7th May, 1909.
WITH reference to your circular despatch of the 31st of March,* I have the

honour to enclose copy of a report by Dr. Forde, the Principal Medical Officer, dated the 3rd of May, with respect to the practicability of acting upon the policy for the prevention of malaria which Dr. Osler describes in his letter as having been so successful in Italy.

I have, &c.,
L. PROBYN,
Governor.

Enclosure in No. 15.

REPORT BY DR. R. M. FORDE, PRINCIPAL MEDICAL OFFICER.

HONOURABLE COLONIAL SECRETARY,

I HAVE read with interest the attached copies of letters on "Malaria in Italy" and on "the Bombay Medical Congress."

With reference to the free distribution of quinine, which is the policy represented by Professor Osler as being so successful in Italy, I do not think we can do any more than has been done here for the past five years, namely, quinine is being given free of charge to anyone who applies for it at all Government dispensaries, the following Standing Order on the subject being in force:—

"Quinine is not to be charged for, and the reason for this should be fully explained to the patients. Medical Officers should encourage the use of quinine as much as possible among the native population."

I should like to have the extra copies of letters for Medical Library if they can be spared.

R. M. F.

3 May, 1909.

No. 15A.

SIERRA LEONE.

OBSERVATIONS BY DR. FORDE, PRINCIPAL MEDICAL OFFICER.

HON. COLONIAL SECRETARY,

I PERUSED the report* with much interest, and now make the following observations on the measures adopted here for the prevention of tropical disease in 1908.

The prevention of stagnant pools of water along the courses of various mountain streams that flow through the town is effected by the canalisation of their beds, so that the small amount of water coming down in the dry season is confined within a narrow channel. These have been repaired during the year, and also the following works have been carried out by the Public Works Department:—

- (1) 1,600 feet of new drains and concrete gutters.
- (2) 4,360 feet of non-masonry drains.
- (3) 164 culverts repaired and cleared.

Hygiene is now regularly taught in all the secondary schools of Freetown, and to encourage this the sum of £180 is provided annually by the Government for distribution as bonuses and prizes to the schools and scholars at the annual examination held in December. The result of this examination shows that the teachers and their pupils take a keen interest in the subject of hygiene, an average of 10 per cent. of the scholars presenting for the examination.

Quinine is distributed at all Government Dispensaries free of charge to applicants on presenting an order from a Medical Officer. And proposals are now under consideration for the better management of cesspits and the disposal of excreta, and also for the drainage of the low-lying lands on the western side of Freetown. In the Protectorate, Medical Officers now take a more active part in the sanitation of towns, making special patrols, when the opportunity offers, during which they give instruction and advice to the chiefs and headmen on matters connected with sanitation, and enquire into the presence of certain diseases, such as leprosy, sleeping sickness, small-pox, &c. Judging from the reports received so far, the results have been quite satisfactory, as many towns which formerly wore a neglected and insanitary appearance are now clean, and the people seem to fully appreciate the advice given

R. M. FORDE.

December 7, 1909.

* [Cd. 4476].

No. 16.

NORTHERN NIGERIA.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 8 July, 1909.)

(No. 330.)

MY LORD,

Government House, Zungeru, 4th June, 1909.

WITH reference to Your Lordship's Circular despatch of the 31st March last* transmitting a copy of a letter addressed to the Editor of "The Times" by Dr. William Osler, on the subject of "Malaria in Italy," and also a copy of a report by the correspondent of "The Times" on the proceedings of the Bombay Medical Congress, I have the honour to enclose a copy of a minute by the Principal Medical Officer, to whom your Lordship's despatch was referred.

I have, &c.,

WM. WALLACE,

Acting Governor.

 Enclosure in No. 16.

SECRETARY,

THE policy referred to by Dr. Osler could well be tried with the children in the native towns in the vicinity of European stations in Northern Nigeria. The expense would, however, be considerable, and would necessitate a special vote. I would recommend that specimens of the various preparations of quinine issued by the Italian Government be obtained and sent here for trial—the price, strength in alkaloid, and formula, to be given. It should be noted when ordering them that they will be exposed to damp and to very high temperatures and should be packed in "lever-lid tins" as a protection from ants, on account of the sugar contained in them.

Experiments might then be made to induce women to give them to their children; but it should be remembered that in Italy the poor people are comparatively intelligent and are anxious for treatment, whereas here it is difficult to break down old customs and to secure the co-operation of the natives themselves. In this connection I should be glad if enquiries could be made as to the possibility of introducing the cinchona tree into Northern Nigeria. If this could be done successfully it would do away with many of the difficulties met with in trying to introduce European methods of medication. The native has always been in the habit of stripping the bark from trees and using the infusion as a medicine, and would, I think, more easily take to this method, which they already understand and appreciate.

S. W. THOMPSTONE,

21 May, 1909.

Principal Medical Officer.

 No. 17.

SOUTHERN NIGERIA.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 16 June, 1909.)

MY LORD,

Government House, Lagos, Southern Nigeria, 27th May, 1909.

IN reply to your Lordship's circular despatch of the 31st March,* I have the honour to transmit copies of two letters from the Principal Medical Officer explaining what is being done locally to combat malaria, and to state that the efforts now being made to that end will not be relaxed.

I have, &c.,

J. J. THORBURN,

Acting Governor.

 Enclosure 1 in No. 17.

Principal Medical Officer, Lagos, Southern Nigeria,

SIR,

30th April, 1909.

I HAVE the honour to acknowledge the receipt of your letter of the 27th instant.

2. So far as I understand it, the policy which has been successful in Italy is the one we advocated and adopted and practised here ever since the mosquito was proved to be the conveyer of the malarial poison. viz., quinine prophylaxis, drainage, and filling up of swamp land, protection from mosquito bites by nets and mosquito-proof buildings, together with such destruction of mosquitoes as is possible.

3. I do not see that we can do any more but by expenditure of more money. It is wholly, now, a question of expenditure.

The Honourable
Colonial Secretary,
Lagos.

I have, &c.,
H. STRACHAN,
Principal Medical Officer.

Enclosure 2 in No. 17.

Principal Medical Officer, Lagos, Southern Nigeria,

SIR, 17th May, 1909.

WITH reference to your letter of the 10th instant, I have the honour to state that we have, without legislation, expended a fair proportion of our vote on gratuitous distribution of quinine for prophylaxis. Last year, 1908, the sum of £232 17s. 6d. was so spent out of a total vote of £2,440 for drugs for the three provinces.

2. We could, no doubt, expend more if we had more applicants for quinine. It would be money well spent; and we might, I think, in time, gradually induce mothers to apply at specified centres (hospitals and dispensaries) for a supply of the drug for their infants. It would, if successful, be quite the best way of helping to extirpate the malaria parasite among natives.

Honourable Colonial Secretary,
Lagos.

I have, &c.,
H. STRACHAN,
Principal Medical Officer.

SOUTH AFRICA.

No. 18.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 17 July, 1909.)

MY LORD, Government House, Cape Town, June 30, 1909.

WITH reference to your Circular despatch of March 31st last,* I have the honour to enclose, for your information, a copy of the undermentioned documents on the subject of the prevention of malaria.

I have, &c.,
WALTER HELY-HUTCHINSON,
High Commissioner.

SCHEDULE OF ENCLOSURES.

1. Despatch from Resident Commissioner, Basutoland. May 12th, 1909
2. Despatch from Acting Administrator, North-Western Rhodesia. May 14th, 1909.
3. Despatch from Administrator, Southern Rhodesia. May 26th, 1909.
4. Despatch from Resident Commissioner, Swaziland. May 29th, 1909.
5. Despatch from Resident Commissioner, Bechuanaland, Protectorate. June 15th, 1909.

Enclosure 1 in No. 18.

RESIDENT COMMISSIONER, Basutoland, to HIGH COMMISSIONER.

MY LORD, Resident Commissioner's Office, Maseru, May 12th, 1909.

WITH reference to your Lordship's despatch of 29th April, 1909, I have the honour to state that I learn from the Principal Medical Officer that malarial fever is unknown in Basutoland, but that should it ever become epidemic in the

* No. 1.

territory there would be no difficulty in carrying out the policy referred to by Doctor Osler.

I have, &c.,

His Excellency

H. C. SLOLEY,

The Right Honourable

Resident Commissioner.

The Earl of Selborne, P.C., G.C.M.G.,

High Commissioner for South Africa.

Enclosure 2 in No. 18.

ACTING ADMINISTRATOR, North-Western Rhodesia, to HIGH COMMISSIONER.

Administrator's Office, Livingstone, North-Western Rhodesia,

MY LORD,

May 14th, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's despatch of the 29th ultimo, regarding a letter addressed to "The Times" by Dr. W. Osler, on the subject of malaria in Italy, and a report by the correspondent of "The Times" on the proceedings of the Bombay Medical Congress.

2. The correspondence has been referred to Dr. Aylmer May, Principal Medical Officer to this Administration, who reports as follows:—

"The method advocated by Professor Osler, namely, the gratuitous distribution of quinine, has been adopted by this Administration amongst a large proportion of the European population of the country, namely, the Government and railway employees, and with very favourable results. Quinine is within the reach of all the remaining European population, farmers, miners, and other settlers, and its use as a prophylactic is advocated on every possible occasion. It is, however, to be regretted that the education of the public opinion on this matter is not as yet by any means complete, there being in fact in some few cases a distinct prejudice against the method. This prejudice and the deductions giving rise to it are combated by every possible means, and I have no doubt will gradually die out.

"The facts of the case, namely, that malaria is present everywhere in native villages, and that by the employment of certain specified precautions Europeans can almost invariably avoid it, are taught.

"The other methods of malarial prophylaxis, namely, the destruction of mosquitoes, and the avoidance of infection through the bites of these insects, the principles of which are frequently explained by the medical officers throughout the territory, and which are as far as possible being adequately dealt with at all stations by advice given to officials, farmers, and other settlers on the habits and breeding-places of mosquitoes, the segregation of native employees, the selection of suitable sites for dwellings, drainage, and the regular use of quinine as a preventative.

"The education of the public on these points is gradually proceeding, and I have no doubt that each year will produce an advance in the efforts made by individuals for their own safety, as well as in the collective efforts made by large employers of labour, and that anti-malarial habits will in time become firmly established.

"The general administration of quinine to the native population is not undertaken, the difficulties of which would be so great, owing to distance, indifference, and prejudice on the parts of natives, that it does not seem practicable. The native population, however, of European stations, and all natives employed in large numbers on construction or other works, are under direct medical supervision, and in these cases anti-malarial measures are instituted and carried out as far as is practicable."

3. It is noticeable that quinine is becoming known and believed in amongst those natives who are constantly employed by Europeans.

I have, &c.,

His Excellency

L. A. WALLACE,

The High Commissioner

Acting Administrator.

The Right Honourable

The Earl of Selborne, G.C.M.G., P.C.,

&c., &c., &c.,

Johannesburg.

Enclosure 3 in No. 18.

ADMINISTRATOR, Salisbury, to HIGH COMMISSIONER.

MY LORD,

Administrator's Office, Salisbury, 26 May, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's despatch of the 29th of April, forwarding a copy of a Circular despatch from the Secretary of State transmitting copies of a letter addressed to "The Times" by Doctor W. Osler, the Regius Professor of Medicine in the University of Oxford, on the subject of malaria in Italy, and a report by the correspondent of "The Times" on the proceedings of the Bombay Medical Congress.

In reply to the second paragraph of your Lordship's despatch, I have the honour to transmit a report by the Medical Director on the question of the extent to which the policy represented by Dr. Osler as having been so successful in Italy could be adopted in this territory.

His Excellency
the High Commissioner,
Johannesburg.

I have, &c.,
W. H. MILTON,
Administrator.

Medical Director's Office, Salisbury, May 19th, 1909.

With regard to the second paragraph of His Excellency the High Commissioner's despatch asking the extent to which the policy represented by Doctor Osler as having been so successful in Italy could be adopted in this territory, meaning the issue of free quinine or facilities for obtaining cheap quinine, I fear that such a policy could hardly lead to much practical results.

This territory cannot be compared with Italy or the, at one time, malarial infested swamps on the shores of the Canadian lakes, for here we have a large native population outnumbering the Europeans many times, who act as the principal disseminators of the disease.

Major Ross urges that malarial prophylaxis should be sought by mosquito destruction in the towns, and quinine in the country districts, but malaria is of little importance now in our larger towns, whilst in the country districts every effort is being made to educate the settler (be he farmer, prospector, or trader) as to the best means to adopt for prevention and treatment, and free quinine would do little to assist, unless it were extended to the native population.

It is conceivable that, if quinine drugging were made a common practice by every individual whether native or European, child or adult (and this could only be attained by the free issue by the State), that in time this territory might become free from malaria. This is an alluring prospect, and, at first sight, one is inclined to think that no difficulties should be allowed to stand in the way, and no expense should be considered too great to attain such a goal.

It is not, I fear, however, within the range of practical politics, so far as this territory is concerned, for the constant stream of alien natives from less favoured countries would continue to convey the malarial germ, and the treatment would have to be continued *ad infinitum*.

The best means at our disposal is the education of the settlers, as to the causes and prevention of malaria, and the eventual spread of this knowledge through him to the native.

A. M. FLEMING,
Medical Director.

Enclosure 4 in No. 18.

RESIDENT COMMISSIONER, Swaziland, to HIGH COMMISSIONER.

Resident Commissioner's Office, Mbabane,

MY LORD,

Swaziland, May 29th, 1909.

I HAVE the honour to acknowledge the receipt of your Excellency's despatch of April 29th, forwarding a copy of a circular despatch from the Right Honourable the Secretary of State for the Colonies transmitting copies of a letter addressed to "The Times" by Doctor W. Osler on the subject of malaria in Italy, and a report by the correspondent of "The Times" on the proceedings of the Bombay Medical Congress.

2. The majority of the Europeans in the country live outside the fever belt, *i.e.*, the low veld. The uses of quinine are well known to the Europeans. The few

living in the unhealthy localities are mostly poor and ignorant, and would be unlikely to carry out a systematic course of treatment unless under the direct supervision of a medical practitioner. I hope that it will be possible before long to station a doctor at Hlatikulu, near where these people are living.

3. The natives living in the low veld suffer from fever to an extent regulated by the rainfall. Last season, owing to exceptionally heavy rains, fever was worse than usual. The Government distributed quantities of quinine, but where supervision could not be exercised no course of treatment would be systematically carried out. All police natives and others under any form of discipline are given a course of quinine during the unhealthy season.

4. The bulk of the Europeans affected are low in the social scale, and they, in common with the natives, could not at the present time be persuaded by any means to use mechanical and anti-plasmodic prophylaxis.

I have, &c.,
R. T. CORYNDON,
Resident Commissioner.

The Right Honourable
The Earl of Selborne, P.C., G.C.M.G.,
&c., &c., &c.,
Johannesburg.

Enclosure 5 in No. 18.

RESIDENT COMMISSIONER, Bechuanaland Protectorate, to HIGH COMMISSIONER.

MY LORD, Resident Commissioner's Office, Mafeking, 15th June, 1909.

I HAVE the honour to acknowledge the receipt of your Excellency's despatch of the 29th of April last, enclosing a copy of a circular despatch from the Secretary of State on the subject of the prevention or reduction of malarial fever.

2. It is clear that in a country like the Bechuanaland Protectorate nothing could be done to reduce the number of mosquitoes in any appreciable degree, and it would be equally impossible to defend the native population from the bites of these insects.

3. As regards the feasibility of reducing malaria by the general administration of quinine to the natives, the Government Medical Officer was asked to furnish a report, a copy of which is enclosed for your Excellency's information.

4. When natives are actually suffering from fever they will readily take quinine if they can obtain it gratis; but under existing conditions in the territory it would be quite impossible, apart from the question of cost, to ensure the regular taking of the drug as a preventative measure.

I have, &c.,
F. W. PANZERA,
Resident Commissioner.

His Excellency
the High Commissioner,
Johannesburg.

GOVERNMENT SECRETARY,
Mafeking,

It may be stated that, in my opinion, to deal adequately with the disease it would be necessary to have medical officers at every staadt, with hospitals, &c. Such an organization could be set in motion at an initial cost of £5,000 per annum for the first two years; which would soon decline to something like £2,000 or £2,500 per annum. This is not great considering the necessities of the population in respect to preventable fatal diseases. I suppose, however, that the finances of the country, at present, would not support such an undertaking; although I feel sure that such a system as I maintain to be necessary in the event of an attempt to properly tackle the matter, would, if based on the Basutoland one, help to pay its way. It is practically certain that the question is a very urgent one, and will have to be faced and undertaken at no distant date.

The cost per head, in quinine alone, could hardly be less than 5s.

On the strength of our verbal discussion of the matter, and your suggestion, I have issued quantities of quinine and phenacetin to the missionaries of Molepolole and Mochudi for the treatment of the indigent fever-stricken in their respective staadts. This I propose to supplement with a supply of Peruvian bark—for the treatment of children—who are the great victims and sufferers.

Kanye will be similarly supplied.

This is the only method I can conceive to be possible, in attempting to reach suitable cases at present. If there were intelligent white non-commissioned officers or troopers on the various stations it would, perhaps, be best to entrust the distribu-

tion of drugs to them. But as the end of the fever season cannot be very distant, any such arrangements or provisions may be left over till next year.

Gaberones,
30 May, 1909.

D. M. MACRAE,
Medical Officer,
Bechuanaland Protectorate Government.

No. 19.

REPORT BY MEDICAL OFFICER, BECHUANALAND PROTECTORATE, ON THE SUBJECT OF ANTI-MALARIAL MEASURES TAKEN IN THE BECHUANALAND PROTECTORATE.

(Received in Colonial Office, 14 August, 1909.)

During the year ending 31st March, 1909, the prevailing disease in the Protectorate has been, as in the past, malarial fever. Owing to the exceptionally heavy rainfall, it has been universal and severe; the mortality amongst the natives has been very great. It is difficult to see how this can be prevented until the people are educated up to some civilised ideas of diseases and their treatment. So far they are largely in the hands of wizards and impostors; and, as regards malaria, seriously influenced by the prejudices—the imperfect and pernicious views—which prevail amongst the white population.

Nor, again, is it easy to see how the education of the Bechuanas in these matters is to be hopefully regarded, since a century of missionary zeal, and, I suppose, twenty-five years of administrative control have left them almost exactly where they were. Livingstone was right: he said, sixty years ago, or nearly, after thirteen years of noble and enthusiastic service amongst them—and no one was more likely to be less prejudiced—that as regards the elevating and redeeming influences of religion and ethics, he regarded them as a “lost race.” The writer believes that much that is necessary towards their physical and moral regeneration must be looked for in that future time when it will be found possible to confer upon this country the advantages of a well-organised medical service.

Quantities of quinine and kindred drugs have been issued to the missionaries for the free treatment of the indigent fever-stricken this year.

As regards the service, a great deal has been done for the past two years towards increasing the comfort and securing the health and general tone of all ranks. Mosquito-proof quarters are almost universal now; the bush and scrub have been cleared over large areas, in the neighbourhood of camps and quarters; a large and constant supply of fresh milk is ensured to all ranks, by the privilege recently extended of keeping cows on the reserve. These innovations, together with the gradual saturation of the service with quinine, which has been slowly going on for years, has had the most marked beneficial influence upon its health and efficiency. Although the service, of all ranks, has been widely affected, the disease did not attack its members with the general severity observable elsewhere, and in very few cases only was convalescence prolonged under prompt and proper treatment.

For the past two years the service on all outstations has been supplied abundantly with quinine. With this and the prolonged administration of the drug which the interchange of sick and convalescent, and of healthy, which goes on between the various stations, ensures, a time may be looked for when the service, as regards the old hands, will be comparatively immune.

Not a single death from malarial fever—*per se*—to my knowledge has occurred within the service during the past year. This also applies to the wives and families of the white and native police, who were mostly ill but under treatment. On the other hand, hundreds of children and adults have perished among the native population whose lives could as surely have been saved by the administration of quinine; yet this drug is always within their reach at the various stores—if we except the desert places, but they somehow prefer to die rather than take any “White Medicine.”

I most earnestly recommend the printing and circulating of a few hundred copies of Sir William Osler’s letter among the various branches of the service, the missionaries, and traders; it is no exaggeration to say that it will, in time, help to save hundreds of lives.

D. M. MACRAE,
Medical Officer,
Bechuanaland Protectorate Government.

WEST INDIES.

No. 20.

BAHAMAS.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 28 September, 1909.)

MY LORD,

Government House, Nassau, September 3rd, 1909.

I HAVE the honour to acknowledge the receipt of your circular despatch of the 31st of March,* with reference to malaria in Italy, and to report that in 1907 I obtained from the Government of India information regarding the sale of quinine at all post offices, and after very considerable hesitation my Government accepted my recommendation for the sale by the Government of quinine at cost price in every district of this Colony.

2. Before the introduction of this innovation the public, other than paupers, had to pay one penny for each three-grain tabloid of quinine. They can now obtain for the same sum six similar tabloids.

3. The instructions† of which I enclose a copy have been widely distributed.

I have, &c.,

W. GREY WILSON.

Governor.

No. 21.

BRITISH GUIANA.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 23 August, 1909.)

Government House, Georgetown, Demerara,

5th August, 1909.

MY LORD,

I HAVE the honour to acknowledge the receipt of your Lordship's Circular despatch of the 31st March,* enclosing a copy of Dr. William Osler's letter to "The Times" on the subject of malaria in Italy, and enquiring to what extent the policy which has been so successful in Italy could be adopted in British Guiana.

2. This Government has already placed quinine practically within the reach of all, by putting it on sale at all the district post offices at cost price, *i.e.*, 30 grains for one penny. The result has been encouraging, as the sales have risen from 326 ounces in 1906-7 to 2,076 ounces in 1908-9. This plan, however, still leaves the initiative as regards consumption to the general public, and it would, I think, be very desirable to bring about the gratuitous distribution of quinine on systematic lines. To this end I have caused the Immigration Agent-General to address all the sugar estates in the circular of which I enclose a copy.

3. One thousand copies of Dr. Osler's letter and the enclosure have also been printed for the use of the Medical Department and distribution by Government medical officers. The Crown Agents have been asked to ascertain where the comfits and chocolates referred to can be obtained and their cost.

4. I will report later on the result of these steps which I hope will be satisfactory.

I have, &c.,

CHARLES T. COX.

Enclosure in No. 21.

(British Guiana. Circular.)

SIR,

Immigration Department, Georgetown, Demerara, 31st July, 1909.

I HAVE the honour, by direction of the Acting Governor, to enclose for your perusal a copy of a despatch from the Secretary of State for the Colonies, covering a copy of a letter addressed to "The Times" by Dr. William Osler, Regius Professor of Medicine at Oxford, on the subject of malaria in Italy.

2. The remarkable results which have attended the gratuitous distribution of quinine, in the reduction of mortality and the improvement in general health,

* No. 1.

† Not printed.

appear to the Acting Governor well worthy of your consideration in connection with the labourers employed on your estate. I am to add that if you desired to adopt the measures therein advocated, the Government would be prepared to import quinine and supply it to you at cost price, which would not exceed 2 cents for every thirty grains.

3. As you are aware, quinine is already on sale at this rate to the public at the district post offices, and sales have risen from 326 ounces in 1906-1907 to 2,076 ounces in 1908-1909. There is little doubt that its benefit might be much extended by systematic and gratuitous distribution, to the great advantage not only of the labourer but of those who need an improved labour supply.

I have, &c.,
W. CRAWFORD,
Acting Immigration Agent-General.

The Manager,
Pln.

No. 22.

BRITISH GUIANA.

EXTRACT FROM THE REPORT OF THE SURGEON-GENERAL FOR
THE YEAR 1908-9.

(Received in Colonial Office 15 November, 1909.)

MALARIAL FEVER AND ANTI-MALARIAL MEASURES.

* * * * *

97. Malarial fever still claims a large number of victims every year, and until the inhabitants of the Colony realize that mosquitos are the carriers of this disease, and join in a general crusade against them it will continue to do so.

98. Most excellent regulations with regard to vat screening have been passed by the Mayor and Town Council, but I regret to say they have not been enforced except at the Government institutions, where the vats and tanks have been made mosquito-proof.

99. Since the year closed Sir Rubert Boyce, from the Liverpool School of Tropical Medicine, has visited the Colony and delivered several very interesting and instructive addresses. He pointed out what the medical profession has been preaching for years, and that is the absolute necessity of abolishing all breeding grounds for mosquitos, in the town, villages, and sugar estates. It is to be hoped that the by-laws above referred to will now be strictly enforced, and also that the example set by many of the West Indian Islands will be adopted, that is, to make it an offence for any persons to harbour mosquito larvæ on their premises by keeping stagnant water unscreened, and old tins, calabashes, &c., in their yards.

100. On some of the sugar estates, as a result of the crusade against mosquitos by the Medical Inspector, assisted by the Medical Officers, a very decided attempt has been made to abolish the breeding grounds, by effectually screening with mosquito gauze all tanks, barrels, and other receptacles for storing drinking water, clearing the yards of old tins, bottles, &c., and keeping the drains clean and free from grass and weeds.

101. The sale of quinine at cost price all over the Colony at the different Post Offices, which was introduced in December, 1906, is steadily increasing, as the following figures will show :—

1906-1907	...	December to March,	326 ounces.
1907-1908	...	March to April,	1,211 ounces.
1908-1909	...	March to April,	2,076 ounces.

These figures show that this privilege is being taken advantage of by the people

* * * * *

103. I am glad to say that steps are being taken to procure quinine put up in chocolate and comfits for use in this Colony.

No. 23.

BRITISH HONDURAS.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 7 June, 1909.)

MY LORD,

Government House, Belize, 20 May, 1909.

WITH reference to your Lordship's circular despatch of the 31st March* on the subject of malaria, I have the honour to forward herewith a copy of a minute by Dr. Harrison, Colonial Surgeon, respecting the policy which has proved so successful in Italy.

2. I am inclined to agree with Dr. Harrison in his view expressed in paragraph 7 of his report that medical officers should be freed from their other duties in order to give more attention to the medical work of their districts. The system by which medical officers are required to perform the duties of District Commissioners, entailing as these do the attending to Board meetings, the keeping of petty accounts for postage and for moneys received for various small works, and other work of a clerical character does not, in my opinion, work well. The medical officers have a great distaste as a rule for this combination of duties, and whenever an emergency arises it becomes necessary to take the District Commissioner's work off their hands by sending down an additional officer. We have lately separated the duties and appointed a District Commissioner as well as a Medical Officer in certain districts, and I would, as our resources increase, like to see the dual duties altogether separated in the Colony.

I am, &c.,

E. J. E. SWAYNE,

Governor.

Enclosure in No. 23.

The COLONIAL SURGEON to the COLONIAL SECRETARY.

HONOURABLE ACTING COLONIAL SECRETARY,

THE policy represented by Dr. Osler is feasible in this Colony, but it will take time to carry out.

In this matter we must consider the class of people we have to deal with. The population is made up of—

- (a) Whites (general).
- (b) Negroes.
- (c) Spaniards.
- (d) Indians.
- (e) Mixed.

2. Of the first the number is small and few given to what I may call chronic malaria. To the intelligent the causes and prevention of malaria are well known and they follow the directions of their medical attendant or are able to treat themselves.

3. The negro is less prone to malaria than the Spaniard or Indian as he takes the precaution of sleeping under a net, and is also not averse to taking quinine, but this is only when he is suffering from fever.

4. The Spaniard is sceptical to the use of quinine; the more intelligent will use it whilst others won't, and many are afraid of the effects, as buzzing of the ears, &c

5. The Indian—He abhors the very name of quinine and prefers disease and death to taking it. In 1891, when travelling through the Cayo and Orange Walk Districts, I was accompanied by Reverend Father Molina (a Mexican). In cases of fever we visited together we could not get the patient to take quinine, and he (Father Molina) assured me that it was the firm belief of some of these Indians that the Government were trying to kill off the race by giving them the drug. The prejudice is gradually dying out, for in later years I treated General Tamai of the Ycaiche Indians and his family and have reconciled him to our methods,

and even lately have received letters from him to send medicine for himself and household.

6. What is required is, firstly, the familiarising of these people to our science by instructing the Medical Officers to take a sympathetic interest in them and their surroundings; and, secondly, the distribution of quinine either free or at cost price.

7. To carry out the first the Medical Officers must be freed from all other duties and be given opportunities to visit their district oftener.

For the second, quinine is cheap now; you can get the sulphate, on taking large quantities, at 7d. an ounce, and could sell the drug at the post offices. The quinine could be sold at cost or distributed free. I do not think this would exceed £50 per annum. It could be got in chocolate-coated fashion and the tannate of quinine used.

In the distribution it must either be entrusted to the Assistant Colonial Surgeons or responsible and trusty people.

J. H. HUGH HARRISON,
Colonial Surgeon.

12 May, 1909.

No. 24.

BRITISH HONDURAS.

EXTRACT FROM THE ANNUAL MEDICAL REPORT BY THE COLONIAL SURGEON, DATED 4TH MAY, 1909.

(Received in Colonial Office 2 August, 1909.)

ANTI-MALARIAL MEASURES.

In Belize much has been done in the way of clearing bush, drainage, and the introduction of the Mosquito Ordinance, so that the numerous cases of fever that used to exist have decreased to a considerable agree. As to the districts, I cannot say that any anti-malarial measures of a vigorous kind have been carried out beyond steps of an advisory and passive nature, the medical officers in the districts advising the patients to take quinine as a prophylactic and to sleep under nets.

Steps to clear the bush have been adopted and the Screening Ordinance brought into force in almost all the districts.

Special attention has been paid to the filling in of puddles and swamps and the general sanitary condition of the several townships advanced considerably, as will be seen by the Registrar-General's report and the medical reports.

The villages and settlements outside the townships are the places where malaria is mostly to be seen. In order to combat this, the medical officers must not be hampered by other duties in order to permit them to visit their districts, advise the people, and report what measures can be adopted to suit each place.

No. 25.

JAMAICA.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 29 July, 1909.)

MY LORD,

King's House, Jamaica, 14 July, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's Circular despatch, dated the 31st of March last,* enclosing a copy of a letter addressed to the editor of "The Times" by Dr. William Osler, the Regius Professor of Medicine in the University of Oxford, on the subject of "Malaria in Italy; a lesson in practical hygiene," together with a copy of a report by the correspondent of "The Times" on the proceedings of the Bombay Medical Congress.

2. In reply I have the honour to inform your Lordship that in the year 1905, on the recommendation of the Superintending Medical Officer, it was decided to supply quinine free of cost to non-acclimatised coolies on estates, as a preventive

* No. 1.

against malaria, but the scheme does not appear to have been given a fair trial, as the employers of the coolies would not ask for the quinine. The matter was again recently considered, and by direction of Sir Sydney Olivier arrangements have been made whereby, on certain selected estates, quinine is regularly administered to all coolies every day, and the results watched in order to compare them with the conditions obtaining previously, and with the health record of neighbouring estates where the practice is not followed. This experiment has not yet been tried for a sufficient period to enable a comparison of the results to be made.

3. A message was addressed by Sir Sydney Olivier to the Legislative Council on the 22nd of February last on the subject of the overcrowding of the public general hospitals in Portland and St. Mary, especially during the rainy seasons of the year, and during the periods when indentured immigrants are being acclimatised, and a Select Committee of the Council was appointed to advise what measures should be taken either to provide the required increased hospital accommodation or by other means to abate the pressure on the hospitals chiefly resorted to by Indian immigrants. I enclose an extract from the report of the Select Committee, from which it will be observed that they do not favour the free distribution of quinine to coolie labourers on estates as a prophylactic measure at the expense of general revenue, but suggest that estate owners be allowed to purchase quinine from the Island Medical Office store at cost price, free of import duty. The Legislative Council have not yet dealt with this report.

4. Having consulted my Privy Council in regard to the matter, after placing before the members your Lordship's circular and enclosures, it has been decided that arrangements should be made for the issue of quinine throughout the malarious districts of the island by the Government at cost price, when requisitioned for by local bodies or employers of labour.

The Superintending Medical Officer has been requested to suggest the steps which should be taken to give effect to the decision.

5. I may mention that the Commissioner of the Cayman Islands states that malarial fever does not, in his opinion, exist in those islands

I have, &c.,
P. C. CORK,
Acting Governor.

Enclosure in No. 25.

QUININE.

It seems to us unreasonable that free quinine should be given to coolie labourers on the estates as a prophylactic measure at the expense of general revenue, but we strongly recommend that all estate owners should supply a daily dose of quinine to their indentured coolies at their own expense, and that a record be kept on each estate of the daily dose given, with the name of each coolie to whom it is given; we also suggest that estate owners be allowed to buy it from the Island Medical Office store at cost price, free of import duty.

We understand that a dose of 5 grains per day would entail a cost of, roughly, £24 annually for every 100 labourers, if given in tablets, and £18, if given in powders.

No. 26.

LEEWARD ISLANDS.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 23 August, 1909.)

MY LORD,

Government House, Antigua, 6th August, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of the 31st March last,* transmitting a copy of a letter by Dr. William Osler together with a copy of a report on the proceedings of the Bombay Medical Congress, and requesting me to report to what extent the policy which Dr. Osler represents as having been so successful in Italy can be adopted in this Colony.

2. As regards Antigua I find a minute of mine dated January, 1904, in which the free supply of quinine to labourers throughout the island is suggested, and though it has not been thought advisable to make the issue of this drug quite free, yet 3-grain powders with the necessary directions printed on them can be obtained at police stations throughout the island for one penny each, the first cost in England as ordered through the Crown Agents being a penny and three-eighths. A supply which will be disposed of at the same rate has been ordered for Barbuda. As regards mosquito destruction in Antigua much is being done in the town of St. John, and there have been during the present month several prosecutions for failure to comply with the terms of the by-law which provides in the usual way for the protection, with wire gauze or other similar material, of water, and the removal of breeding places. A copy* is enclosed. Mr. Jarvis, Acting Colonial Secretary, has taken a great deal of interest in mosquito destruction, and the City Commissioners are fully alive to the necessity of ensuring compliance with the by-law I have referred to. Unfortunately, swamps which could not be drained save at a cost far beyond the means of the Presidency render the free use of quinine the only effectual means of fighting malaria in the country districts.

3. I think that more should be done as regards the supply of quinine, and when it is remembered what a very great asset our cheap labour is, and how large a number of the labouring population malaria incapacitates, it seems to me that a small sum might be placed on the Estimates for the next few years for the supply of free quinine throughout the island. The ministers of the various denominations would, no doubt, be glad to help in the matter not only as regards distributing the drug amongst those who need it, but in making the people familiar with its use. I should like to see the time when no minister of religion would think of going his rounds without a packet of quinine powders in his pocket.

4. As regards St. Kitts, the Acting Administrator reports that, malaria not being generally prevalent in that Presidency, special prophylactic measures as to facilities for obtaining quinine have not been undertaken, but special measures for mosquito destruction have been in force for some time. A further report on the matter is contained in the Administrator's despatch of the 17th July, which forms an enclosure to my despatch of the 24th ultimo.†

5. The Administrator of Dominica reports that Dominica cannot be viewed generally as a malaria island, but he proposes to distribute supplies of quinine amongst the Government teachers and the police stations of the island. Poor persons suffering from malaria would be given the drug free of charge. I cannot say that I am altogether satisfied with the measures proposed to be taken in Dominica as I think more might be done in the town of Roseau, but this is so very much a matter for the Administrator and the Town Board that I think it would be wise to leave things as they are for the present, keeping meanwhile a careful eye on the medical reports.

6. As regards Montserrat a very happy state of things exists. Dr. Duke reports that true malarial fever of a bad type is extremely rare, and Dr. Heath says he has never seen a case of typical malaria which he has not been able to trace to previous infection in another island, and that he has never been able to identify a specimen of the anopheles mosquito.

7. As regards the Virgin Islands, the Commissioner is arranging for quinine to be sold at cost price at the schools and post offices. There is little real poverty in that island, and the labourers can afford to pay for the quinine.

I have, &c.,

E. ST. JOHN BRANCH,
Acting Governor.

No. 27.

LEEWARD ISLANDS.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 6 September, 1909.)

MY LORD,

Government House, Antigua, 16th August, 1909.

In my despatch of the 6th instant,‡ reporting the anti-malarial methods

* By-law 2 of 1907 : not reprinted.

† Not printed.

‡ No. 26.

taken in this Colony, I regret I inadvertently omitted to make mention of the introduction of the fish known as "millions," and the following should have appeared at the end of paragraph 2 of the despatch in question:—

"Great success has, however, attended the introduction in Antigua by the Imperial Department of Agriculture of the fish known as 'millions' (*Girardinus poeciloides*, de filippi). An interesting account of these fish appears in the 'West Indian Bulletin,' Volume IX., No. 4, page 382. Great care is taken by the Country Board of Health and the City Commissioners to keep the ponds and streams in the country districts and the ponds in St. John's well stocked with these fish, and there is no doubt that they do excellent work in keeping down the numbers of mosquitoes. Ponds of any size which become dry are restocked as soon as the rains fill them again, and every effort is made to ensure the presence of these enemies of the mosquito in all the waters of the island. The Chairman of the Country Board of Health, Mr. Warneford, has given the matter his especial attention."

I have, &c.,

E. ST. JOHN BRANCH,
Acting Governor.

No. 28.

TRINIDAD.

ANNUAL REPORT OF THE SURGEON-GENERAL FOR 1908-9.

(Received in Colonial Office, October 3, 1909.)

(Extract.)

Surgeon-General's Office, Trinidad, 12th June, 1909.

Anti-Malarial Measures.

Although much remains to be done, there has been accomplished in recent years much good work here in this direction, but sufficient credit for the encouraging results obtained does not appear to have accrued to the Colony, which in some quarters suffers an unenviable and, I think, undeserved notoriety for unhealthiness and indifference to the requirements of modern sanitation.

It might be invidious to suggest a true cause for this attitude, but I embrace this opportunity of correcting any misrepresentations in the matter that may be abroad, believing that the Colony generally, and Port-of-Spain, the chief town, especially, have nothing to fear, but substantial advantages to be gained, from the widest possible dissemination of *accurate* knowledge in regard to our general health conditions, which, I believe, compare favourably with those of any other tropical country or town in similar circumstances, and which are injuriously affected in no true sense by the occasional occurrence of an isolated case of infectious disease for the control of which the sanitary organization has successfully displayed its complete ability.

The abundant and excellent water supply in Port-of-Spain, the installation of a water-carriage sewerage system rapidly nearing completion, the magnificent and well-designed drains that in every direction permeate the town and its environs, the excellent surface maintenance of the streets, the substitution of asphalt for macadam in many of them, and their regular methodical scavenging, the care bestowed upon the foot-ways and on minor drainage details—all these have contributed practically to banish malaria from Port-of-Spain, and as a result of Special Regulations now in force the *stegomyia* or yellow-fever-bearing mosquito is fast becoming an unknown denizen of our houses.

Mosquito-proof rooms have been provided in the two principal hospitals, and two new residences for medical officers now nearly completed in notoriously malarial districts will be rendered mosquito-proof upon my recommendation.

Educational aid has not been ignored in this connection. Many elementary school teachers have already become imbued with the importance of hygienic and anti-malarial instruction, and they have now in their hands an excellent text-book compiled by Dr. Dickson—recently revised and issued in its second edition—which in simple language clearly relates the causes of the commonest tropical diseases and forcibly enunciates the best methods of combating them.

The training of assistant sanitary inspectors is now ensured by an annual course

of lectures and demonstrations to which school teachers, sub-officers, and men of the constabulary and others have access, and certificates of proficiency are distributed to deserving candidates after competitive examination at the conclusion of the course of instruction. It is intended to recruit the staff of assistant sanitary inspectors exclusively from the ranks of those who have secured these certificates, and eventually to distribute these trained officers at improved rates of pay throughout all districts, where their whole time will be retained for sanitary inspection and cognate duties. It may reasonably be anticipated that the efforts and influence of these expert sanitarians will produce good results and help to redress many of the more prominent and remediable features of insanitation that unfortunately are now tacitly suffered to prevail.

In view of all this incontestable evidence of the high standard of sanitation that is maintained in Trinidad and especially in its port, and bearing in mind also the care and precision with which the Quarantine Convention Regulations are now enforced here both in regard to our own defence and also to the protection of other countries from infection when it exists here, it certainly is inconsistent that upon the slightest pretext we should still be the victims of harsh and unreasonable quarantine restrictions of indefinite duration, imposed against us directly or indirectly by neighbouring countries and even by British Colonies whose internal methods of protection leave much to be desired in both organisation and efficiency when compared with our own.

A wide advertisement of the true position we occupy in the circumstances would appear to afford a hopeful means of correcting the fallacious impressions that prevail to the detriment of the Colony.

No. 29.

WINDWARD ISLANDS (GRENADA).

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 15 June, 1909.)

MY LORD,

Grenada, 20th May, 1909.

I HAVE the honour to acknowledge the receipt of your Lordship's circular despatch of the 31st March,* relative to the policy advocated by Dr. Osler in the treatment of malaria.

2. The Executive Council in Grenada, by whom the matter has been considered, is of opinion that malarial fever is not widespread in the Colony, nor of the same virulent type which characterises it in some other countries, the majority of the people being free from it, and conditions generally improving in this respect.

3. The expenditure which would be involved by the distribution of free quinine, recommended by Dr. Osler, does not, therefore, seem to be justified in Grenada under existing conditions.

I have, &c.,

RALPH WILLIAMS,
Governor.

AUSTRALIA.

No. 30.

THE GOVERNOR-GENERAL to THE SECRETARY OF STATE.

(Received 27 November, 1909.)

MY LORD,

Governor-General's Office, Melbourne, 21st October, 1909.

REFERRING to your Lordship's circular despatch, dated 31st March, 1909,* transmitting a copy of a letter addressed to the Editor of "The Times" by Dr. William Osler, relative to malaria in Italy, I have the honour to forward, herewith, copies of communications on the subject which have been received from the Governments of Queensland, South Australia, and Western Australia—the only States in the Commonwealth in which the disease occurs

2. The Papuan authorities have been asked to furnish a report, a copy of which will be forwarded immediately upon receipt.

I have, &c.,
DUDLEY,
Governor-General.

Enclosure 1 in No. 30.

SIR, Chief Secretary's Office, Brisbane, 8th July, 1909.

CONTINUING my letter of the 16th ultimo, relative to the despatch you have received from the Secretary of State for the Colonies, accompanied by a copy of a letter addressed to the Editor of "The Times" by Dr. William Osler, Regius Professor of Medicine at Oxford, on the subject of malaria in Italy, I have the honour to append hereto the full text of a memorandum which I have received on the matter from the Queensland Commissioner of Public Health, to whom Lord Crewe's letter and enclosure had been submitted for report:—

"In answer to question 2 of the circular despatch of the Secretary of State for the Colonies, I may say that measures based on the defence of the habitation and the individual from the bites of mosquitoes have already been discussed by the medical officers of health to the local authorities and myself. In some cases the local authorities have made by-laws for the proper screening of tanks, the drainage of swampy grounds, and the oiling of water supplies as prophylactic measures against such diseases as are carried by mosquitoes, *e.g.*, filariasis, malaria, yellow fever, and dengue fever. There is but little malaria in the southern portion of Queensland, but the gratuitous distribution of quinine to the poor, and to all workers in malarial localities of the north has not as yet been considered."

The Honourable
The Prime Minister of the Commonwealth,
Melbourne.

I have, &c.,
W. KIDSTON.

Enclosure 2 in No. 30.

SIR, Premier's Office, Adelaide, 11th October, 1909.

REFERRING to your letter of 9th June last, on the subject of "Malaria in Italy," and a report on the proceedings of the Bombay Medical Congress, I have the honour, in reply to the inquiry as to what extent the policy which Dr. Osler represents could be adopted in this State, to enclose an extract from a report by Dr. W. Ramsay Smith, Chairman of the Central Board of Health, relating to the result of experiments in the Northern Territory:—

"As an illustration of the practical value of this work of sanifying, the following facts have been brought under my notice quite recently. Last year, at the Daly River Smelting Works, out of about 20 employees, five died of malaria, and every other man employed had to go to Port Darwin for treatment. Early this year Dr. Strangman proposed to the Government that they should try preventive measures in the way of improved camp hygiene, treatment of the swamps by petroleum, and the systematic use of quinine by the employees. The investigations I had made in the Northern Territory regarding the use of laxatives were not forgotten, and a plentiful supply was made available at the smelting works, so that the employees could help themselves at their pleasure. The Government Resident went to the Daly, and initiated a régime which the men took up with enthusiasm. The result, so far, has been most gratifying. There has not been a single case of malaria amongst the employees this year, although the natives and others have suffered as badly as before. This is additional proof of the truth of the statement that colonising and sanifying in the tropics are synonymous terms."

I have, &c.,
A. W. PEAKE,
Premier.
The Honourable
The Prime Minister of the Commonwealth of Australia,
Melbourne, Victoria.

Enclosure 3 in No. 30.

SIR,

Premier's Office, Perth, 1st September, 1909.

IN reply to your letter of the 9th June (No. 2414), on the subject of malaria in Italy, and more particularly in regard to paragraph 2 of the letter from the Right Honourable the Secretary of State for the Colonies, dated 31st March, I have the honour to state that my colleague, the Hon. Colonial Secretary, advises me that as result of careful enquiries he finds that malaria only exists north of the 20th parallel in this State, and no systematic measures have yet been put into force against it, seeing that the country is so sparsely populated, and chiefly supports pastoral industries.

The enclosures to your letter have received the careful consideration of our Principal Medical Officer, and I thank you for having submitted the same for perusal.

I have, &c.,

N. J. MOORE,
Premier.

The Honourable

The Prime Minister of the Commonwealth,
Melbourne.

MEDITERRANEAN.

No. 31.

CYPRUS.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 8 May, 1909.)

MY LORD,

Government House, Nicosia, 27 April, 1909.

IN paragraph 16 of my despatch of the 28th of January last,* I had the honour to inform your Lordship that in order to meet the complaints, voiced in the Legislative Council, against the irrigation works in the Messaoria, I had appointed a Commission of Enquiry for the purpose of investigating the serious allegations that the properties and the health of the people in the Messaorean villages were prejudiced and injured by the system of storage and distribution of the water.

2. The Commission, under the presidency of the Director of Public Works, made an exhaustive enquiry, both from an economic and also a hygienic point of view, and eventually presented a unanimous report recommending the carrying out of certain remedial measures which, in the opinion of the members, would remove what were recognized to be the just complaints of the people. The engineering works which were held to be necessary were estimated to cost £1,000, and the Director of Public Works proposed to spread the expense over a period of two years.

3. In the Estimates for the current year provision has been made for the expenditure of £500 on the works which the Director of Public Works considered to be urgently necessary, and I hope, therefore, that the Elected Members, when the vote for the maintenance of the irrigation works is submitted to them, will not refuse to pass it.

4. Certain measures recommended by the Hygienic Sub-Committee of the Commission are now under the consideration of the Chief Medical Officer, who will advise the Government what steps should be taken to improve the sanitary and hygienic conditions of the villages and people affected by the reservoirs.

5. There has been some unavoidable delay in the printing of the report† of the Commission, but I now enclose six copies for your Lordship's information.

I have, &c.,

C. A. KING-HARMAN.

* Not printed.

† Not reprinted.

No. 32.

CYPRUS.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 2 October, 1909.)

MY LORD,

Government House, Troodos, 22 September, 1909.

I HAVE the honour to report that, as stated in paragraph 4 of my despatch of the 27th of April,* the measures recommended by the Hygienic Sub-Committee of the Commission appointed to enquire into the working of the irrigation reservoirs in the Messaoria were referred to the Chief Medical Officer for advice as to what steps should be taken by the Government to improve the sanitary and hygienic conditions of the villages and people affected by the reservoirs.

2. In due course, Dr. Williamson, the Acting Chief Medical Officer, advised (1) that the general recommendations made by the Commission on pages 8 and 9 of the report should be adopted; (2) that the medical officers in the affected area should be notified to give to the villagers the necessary explanations in regard to the transmission of malarial fever by mosquitos, the benefit of using a mosquito net, and the prophylactic action of quinine salts; (3) that arrangements should be made for the distribution of quinine to the people of the infected villages; (4) that either Dr. Cleveland or himself should be appointed as the specially qualified medical man mentioned in paragraph 9 on page 9 of the report for superintending, in conjunction with the Director of Public Works, the carrying out of the recommendations of the Commission.

3. On receipt of Dr. Williamson's report I issued instructions to the medical officers in the affected area to endeavour to instil into the minds of the inhabitants of Acheritou, Ayios Luka, Encomi, Gaidhoura, Kalopsyda, Kouklia, and Prastio the principles contained in the recommendations of the Hygienic Sub-Committee, and also to visit regularly the infected village of Acheritou, where the malaria appeared to be most prevalent. Steps were also taken to ascertain what amount of quinine would be required for the villagers, and a supply of 400 ounces of the drug, costing £14 18s. 10d., was requisitioned from the Crown Agents. The Director of Public Works is engaged in carrying out engineering operations at Acheritou and elsewhere up to the limit of £500 authorised in the Estimates, and, in conjunction with the Principal Forest Officer, is arranging for the planting of eucalyptus and pine trees around the reservoirs. A law has also been passed in the Legislative Council for the preservation of the fish in the irrigation channels and drains.

4. Acting also on the advice of Dr. Williamson, Addendum B, on page 12 of the report, dealing with the transmission of malarial fever by the mosquito, has been printed in Turkish and Greek and distributed among the infected villages.

5. It is hoped that by carrying out the above-mentioned measures the health of the area affected by the storage of water in the reservoirs will be improved; but it is still too soon to pronounce definitely on the subject. With regard to the expense of the operations, they will be shared by the villagers wherever possible by giving their labour.

6. I have deferred the appointment of the special medical man till the return of Dr. Cleveland, the new Chief Medical Officer, from leave, and I shall then confer with him as to how far such a special appointment may be necessary.

I have, &c.,

C. A. KING-HARMAN.

No. 33.

CYPRUS.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 4 December, 1909.)

MY LORD,

Government House, Nicosia, 25 November, 1909.

WITH reference to your Lordship's despatch of the 15th of October,† on the subject of the measures for the removal of sources of malaria in the affected

* No. 31.

† Not printed.

villages of the Messaorea, I have the honour to transmit, for your Lordship's information, a copy of a report by the Chief Medical Officer in which he shows that the measures which have been taken have resulted already in a marked improvement in the health of the people.

I have, &c.,
C. A. KING-HARMAN.

Enclosure in No. 33.

HONOURABLE CHIEF SECRETARY,

THE prophylactic and hygienic measures recommended by the Commission have been carried out, resulting in a marked improvement in the health of the inhabitants of these villages. At the same time there has been a great decrease in the number of mosquitoes.

The medical officers' reports show that the health of the villages has greatly improved, and the returns of the Rural Medical Officer of Athna, whose itinerary covers these villages, show that there have been a very few cases of illness during the last summer.

I propose, with the medical officers of the district, to see that the good sanitary conditions now existing, and the anti-malarial measures which have been adopted, are continued in the future.

By the distribution of printed leaflets, translated into Turkish and Greek, the villagers have been made acquainted with the various prophylactic means of avoiding malarial fevers. A special stock of 400 ounces of quinine has been imported, and part of this has been distributed to the inhabitants of the affected villages, the balance remaining in store for distribution in succeeding summer.

The recommendations of the Committee regarding the use of petroleum, cultivation of fish, and cleaning of irrigation channels have been carried out

R. A. CLEVELAND,
Chief Medical Officer

19th November, 1909.

APPENDIX II.

ABSTRACT OF WORK ON THE EXPERIMENTAL TREATMENT OF TRYPANOSOMIASIS CARRIED OUT DURING THE PRESENT YEAR UNDER THE SUPERVISION OF A SUB-COMMITTEE OF THE ROYAL SOCIETY.

The following account is an abstract of the continuation of the work of which reports have been printed in the "Report of the Advisory Committee for the Tropical Diseases Research Fund" for the years 1907 and 1908, and is chiefly concerned with experiments made with various antimony compounds upon rats and dogs. Experiments made with a few other substances which it was thought desirable to try have also been included.

1. FURTHER OBSERVATIONS ON THE EXPERIMENTS MENTIONED IN THE LAST REPORT.

A series of rats treated with sodium antimonyl tartrate lived for 371 to 428 days after inoculation, and were regarded as cured.

A series of rats treated with antimony (metal) in Colonel Lambkin's medium lived for 205 to 399 days after inoculation, and were regarded as cured.

2. RESULTS OF FURTHER EXPERIMENTS MADE SINCE THE DATE OF THE LAST REPORT.

As mentioned in the last report very good results had followed treatment of infected rats with lithium antimonyl tartrate. We have carried out an extended series of experiments with this salt, and find that with four doses of 4 or 5 minims of a 1 per cent. solution practically every rat can be cured. They have lived up to a year, and in no case have trypanosomes been found after death in the blood or organs. No treated rat has died of the disease, and in no case thus treated has there been a recurrence, so that the results seem to be more constant than those obtained with the sodium or potassium salts. If, however, the treatment is not begun until the fifth or sixth day of the disease, when the blood is swarming with trypanosomes, no permanently good effect is produced. The time,

therefore, at which treatment is begun is of importance. A series of properly treated rats was taken, and one was killed at various times from the sixth to the thirty-first day after the last dose, and inoculations from the blood, liver, and bone-marrow were made into other rats. The results were entirely negative, confirming the view that such treatment was curative.

Further experiments have been made with antimony sodium lactate, with fairly good results. The rats lived up to 100 days, and in no case were trypanosomes found after death. The results with antimony sodium calcium lactate were not so good. These substances were tried on dogs, but the effective dose became inconveniently large.

As mentioned in the last report, the administration of the metal antimony itself (in a state of finest division) appeared to have relatively the greatest effect on the trypanosomes, and experiments have been carried out in order to find some medium in which this substance would be unirritating to the tissues. Various oils, fats, egg-yolk, &c., have been tried, but the metal is extremely irritating to the tissues in whatever medium it is given.

In response to a suggestion made by Dr. Guillemard, of Cambridge, an infusion of quassia, which is poisonous to some forms of life, was tried. It was found to be of no use to the infected animal, and it does not kill trypanosomes *in vitro* after two hours' exposure. It was also tried intravenously in rabbits, with no result.

Experiments on rats were made with arseno-phenyl-glycin, kindly sent by Professor Ehrlich, who found it to be curative in the case of mice. In rats, in our hands, it has not had a corresponding effect, and repeated doses caused toxic effects. The corresponding doses became inconveniently large for the bigger animals, so that there are considerable practical difficulties in its use. In *in vitro* experiments it took five hours for the trypanosomes to disappear.

It has been ascertained that the blood of a normal rat treated with antimony has no trypanocidal action.

In view of the economic importance of the larger animals, experiments on the treatment of trypanosomiasis in dogs and goats have been continued. Of dogs treated with antimony and its salts, one was killed 15 months after inoculation and was found to be cured; others have lived from 40 to 175 days, and of these some may be fairly supposed to be cured. Dogs are very susceptible to antimony, and to trypanosomes, and therefore the results obtained are not wholly unsatisfactory. But in many of them the ordinary subcutaneous and intramuscular injections of antimony or its salts cause swellings and often abscesses, with constitutional disturbances, so efforts have been made to administer these substances intravenously, with very marked results. The metal has been found to be more effective than the salts, but neither cause any irritation or distress when administered intravenously. The animals do not lose weight or appetite, and the results on the trypanosomes have been so far encouraging. In larger animals this method of administration would be far less difficult, and if it should turn out to be successful in dogs, would give hope of a practical method of dealing with the larger animals. The trypanosomes are driven out of the blood in about $2\frac{1}{2}$ hours after the administration of a dose of, say, 10 mg. of the metal to each kilogramme of body weight. Dogs are living and well from 34 to 118 days after the inoculation. These results, apart from the freedom of irritation, are far better than those obtained by subcutaneous or intramuscular injections.

Two goats have been treated, one with the metal and one with the lithium salt. Both are well 157 days after inoculation, and would appear to be cured.

Three rabbits have also been treated intravenously: treatment was only begun when they were very ill, and they are living and well 64 days after inoculation. Two were treated with the metal and one with the lithium salt.

Dr. Morgan, of the Royal College of Science, kindly sent a new arsenic-camphor compound and a new organic antimony compound, both of which he had prepared for the first time, for trial. These compounds were irritating to rats, and were not so effective as those above mentioned.

A paper giving details of the experiments up to 26th June, 1909, has been published in the "Proceedings of the Royal Society," B. Vol. 81, p. 354.

Captain W. B. Fry, R.A.M.C., has assisted me in the carrying out of this work since the date of the last report.

H. G. PLIMMER.

November 11, 1909.

APPENDIX III.

REPORT OF THE PROFESSOR OF PROTOZOOLOGY FOR THE YEAR
ENDING JUNE 30TH, 1909.

I.—GENERAL.

Dr. J. D. Thomson, who has been one of my assistants since I first took up my appointment, resigned his post at the end of 1908. The University appointed in his place Miss Muriel Robertson, M.A. (Glasgow), Carnegie Research Scholar, who has published a number of important researches on protozoa, and who has recently returned from an expedition to Ceylon, where she collected a large quantity of valuable material for the study of various parasitic protozoa.

Owing to the additions and structural alterations that have been in progress at the Lister Institute since the end of last year, we have been obliged to move for a time from the laboratories and rooms hitherto occupied by the Protozoological Department into smaller temporary quarters on another floor. On account of the confusion and discomfort entailed by these building operations, it seemed to me a suitable opportunity to go abroad and undertake certain researches, the nature of which is described in detail below. Accordingly I left England with Dr. Woodcock in the middle of January on a visit to the Zoological Station at Rovigno, in Austria. I returned to England and to the Lister Institute at Easter in order to give my course of lectures in the summer term. Dr. Woodcock, however, stayed on at Rovigno, and has recently returned to England. Our Department is still in temporary quarters, but we hope to move back into our former rooms in a month or two. As the result of the building changes our laboratories have undergone increase in size and number, and when we settle down again we shall have much better quarters than we had before.

In August and September of 1908, I spent about five weeks in Mr. Gurney's Laboratory at Sutton Broad, Norfolk, studying the blood-parasites of freshwater fishes, assisted by Dr. Thomson. With the exception of this period and that occupied by my visit to Rovigno already mentioned, I was working at the Lister Institute during the whole year covered by this report.

II.—SPECIAL.

(1) RESEARCH.—During the past year I have been occupied chiefly by three lines of research; (a) investigations upon the trypanosome of the common rat, *Trypanosoma lewisi*; (b) investigations, in collaboration with Dr. Woodcock, upon the blood-parasites of the little owl, *Athene noctua*, and other parasitic protozoa found at Rovigno; (c) investigations upon the blood-parasites of freshwater fishes.

(a) *Investigations upon Trypanosoma lewisi*.—The "trypanosome problem," as it may be termed briefly, is one of the most important branches of investigation in the whole range of protozoology. Under this problem, in its zoological aspects, is included the distinction and recognition of different species of trypanosomes; the structure and general morphology of trypanosomes; the affinities, systematic position, and origin of this important group of blood-parasites; their life-histories and modes of transmission from one host to another; and their development within, and effects upon, the vertebrate hosts, in the blood of which they are parasitic. The medical aspects of the problem may be divided generally into, first, practical measures for prevention and prophylaxis, for which the zoological investigations are a necessary antecedent, and secondly, curative measures based upon investigations on the effects of drugs and treatment upon animals infected with trypanosomes and suffering from diseases caused by them.

At present the trypanosome-problem is in a very chaotic state, and has baffled the efforts of many skilled investigators, owing to the peculiar difficulties presented by these parasites. There is scarcely a detail even of the minute structure of trypanosomes upon which authorities are agreed; the most conflicting views are held as to their affinities and origin; and in the all-important question of their life-history, development, and transmission there are two opposed schools of thought, some investigators believing that trypanosomes do not go through any true development, but only at most a process of multiplication, in the invertebrate hosts which transmit them from one vertebrate to another; while other authorities are of opinion that trypanosomes go through a distinct cycle of development in the verte-

brate host, comparable to that which the malarial parasite passes through in the mosquito.

In London *T. lewisi* occurs commonly as a parasite of wild rats, both *Mus decumanus* (= *norvegicus*) and *M. rattus*. It is a harmless parasite of rats, easily obtained and easily transmitted to tame rats, to which it is also comparatively innocuous and apparently non-pathogenic, even when swarming in the blood of the rat. Its development and transmission must be proceeding naturally every day in our midst. Hence *T. lewisi* presents itself as a peculiarly favourable object in which to study at least the zoological aspects of the trypanosome problem, and has already been the subject of many investigations. For this reason I have begun and am continuing a series of studies upon this common parasite, in collaboration with Dr. J. D. Thomson.

Since all investigations upon the minute structure and life-history of any trypanosome have to be carried on mainly by the aid of a very complicated technique, with the object of preserving and rendering visible the structure of these minute organisms; and since, further, no such technique is perfect, but all methods deform these delicate organisms and produce artificially greater or lesser changes in their structure, it seemed to me of great importance to begin by a study of the effects upon the trypanosome body, and upon its minute structure brought about by the methods of technique commonly in use, in order to be able to discount the defects inseparable from any given method, and to estimate how far the microscopic image furnished by it is a departure from the truth. As stated in my last report, I have been engaged upon this investigation for some time. My departure for Rovigno in January last set a term to these studies. While at Rovigno I sifted and arranged my results and wrote out a memoir, which I sent for publication to the Quarterly Journal of Microscopical Science, illustrated by three plates; I have recently revised the proofs of this article, which is to be published shortly. My memoir is divided into two parts; in the first part I describe in detail, and compare, the effects of various methods of fixing and staining *T. lewisi*, with the help of figures of the parasites so preserved, drawn to scale accurately at a magnification of 3,000 diameters; in the second part I describe the structure of the parasite in all details, as deduced from a comparison of the results yielded by the methods employed. In this memoir I confine myself to the so-called adult form of *T. lewisi*, after the multiplication-period is over, because then the variation in size and structure of the parasites is very slight and its uniformity in all features makes it the more suitable for estimating the effects produced by technique. I am now engaged in studying the parasite during the multiplication-period by the methods found most suitable for preserving and demonstrating its minute structure. In the early period of infection the trypanosomes exhibit the utmost variation in size and structure, and multiply by several distinct methods of fission.

At the same time I am engaged in investigations upon the natural methods of transmission of *T. lewisi* from rat to rat, and in observations upon the development of the parasite in the insects which transmit it. I referred to this point in my report of last year, and stated that I had obtained negative results in my experiments with lice, and that I had had great difficulty in procuring rat-fleas for my experiments. I purchased some fifty rat-fleas at a cost of about £2. These fleas were turned loose into specially-constructed cages and provided with food. They remained in the cages all the winter, and bred with very great rapidity. When I returned from Rovigno at Easter I found the cages containing thousands of fleas. The species was kindly identified for me by the Hon. Charles Rothschild as *Ceratophyllus fasciatus*. Immediately upon my return I began making experiments on the transmission of *T. lewisi* by these fleas, using naturally-infected wild rats as the source of the infection and endeavouring to transmit the infection from the wild rats to healthy tame white rats. For the experiments cages were used constructed on the plan of those invented by the Plague Commission for similar experiments on the transmission of plague. My experiments are still in progress, and I hope to publish them *in extenso* at a future time. I have already obtained a number of interesting positive results, which may be stated briefly as follows:—

- (1) Can the rat-flea transmit *T. lewisi* from infected to healthy rats? An answer in the affirmative was soon obtained to this question, though the results are sometimes negative. I believe that in many cases tame white rats are refractory to the infection; it is shown by the ordinary method of intra-peritoneal inoculation of blood from infected rats

that the infection does not always take effect. Sometimes the rats acquire only a very slight and transitory infection, easily overlooked. Hence negative results must be discounted.

- (2) Is the transmission of the direct mechanical kind, or does it indicate a cycle in the invertebrate concerned? I have found an interval of about three weeks, more or less, between the removal or death of the infected rat and the appearance of the infection in the previously healthy rat. This result, similar to that obtained by Professor Kleine in the transmission of pathogenic trypanosomes by tsetse-flies in Africa (confirmed by Sir David Bruce), is incompatible with direct infection, and indicates the existence of a cycle of development in the flea.
- (3) When the fleas have once become infectious, do they retain this property? In cages in which an infected rat has been placed for a short time and removed, I have had successive infections of healthy rats introduced and changed, so soon as they became infected, for other healthy rats. This indicates that when once the fleas have become infected, they retain their infective power for some time, as Kleine found also with tsetse-flies.

Other experiments are now being carried on in order to obtain more precise data on certain points concerning the mode of infection thus:—

- (1) By colonizing clean cages with fleas from infectious cages, to make quite sure that the fleas, and nothing else, are the agents in producing infection.
- (2) By feeding rats with fleas from infected cages, to see if they can acquire the infection in this way.
- (3) To determine how long the fleas retain their infectiveness.
- (4) To determine the precise length of the incubation-period in the flea.
- (5) To determine the precise length of the multiplication-period of *T. lewisi* in the rat when infected by fleas.

And other questions that arise.

I have also made preparations of the stages of *T. lewisi* in the flea and put them aside for study at a convenient time, as during the past two months I have been so occupied in preparing and delivering my course of lectures that I have had but little time to do more than exercise a general supervision over the experiments with the fleas. Dr. Thomson, who has now returned from Ceylon, will continue to collaborate with me in these investigations.

(b) *Investigations upon the blood-parasites of the Little Owl* were undertaken by Dr. Woodcock and myself in order to solve some very important but disputed points in the trypanosome problem, arising out of certain statements concerning the parasites of the Little Owl published by the late Dr. Fritz Schaudinn in 1904, shortly before his lamented death. Schaudinn's memoir was termed by him a preliminary communication, and in it he gave only the general results of his investigations, stating that in a later memoir (which he did not live to publish), he would describe fully the complicated methods whereby he had arrived at his remarkable conclusions, of which the following is a brief outline.

The Little Owl (*Athene noctua*), a bird common in Central and Southern Europe, but not indigenous in England, is found to be infected by the following forms of parasites:—

- (1) A "*Proteosoma*," the ordinary type of avian malarial parasite.
- (2) A "*Halteridium*" (*Haemoproteus noctuae*), another common type of avian blood-parasite, previously also classed with the malarial parasites, with which it agrees in being intra-corpuseular, amoeboid, and pigmented, and in "flagellating" when fresh-drawn blood containing the parasite is cooled down on the slide, that is to say, the male forms produce a number of thread-like microgametes, commonly (but incorrectly) spoken of as "flagella."
- (3) A small trypanosome.
- (4) A large trypanosome.
- (5) A parasite of the white corpuscles, *Leucocytozoon ziemanni*; it is also intra-corpuseular, though not amoeboid nor pigmented, and when the blood is drawn, the male forms "flagellate," in the same manner as the

malarial parasites. This form was also, in fact, classed with the malarial parasites by Laveran under the name *Haemamoeba ziemanni*.

(6) A spirochæte.

According to Schaudinn, these six forms belong to the life-cycle of three distinct parasites, namely:—

- I. The "*Proteosoma*" (1) is a distinct entity, not connected with any of the other forms.
- II. The "*Halteridium*" (2) and the small trypanosome (3) are two forms of the same parasite, which in its development is stated to occur alternately as an intra-corpuseular *Halteridium* by day, and as a trypanosome free in the blood-plasma by night. When full grown, the *Halteridia* either become free in the blood as trypanosomes, which multiply rapidly by repeated fission (indifferent forms), or remain intra-corpuseular, and are differentiated into male and female gametocytes, which do not develop further in the bird. The gametocytes require to be taken up by a mosquito (*Culex*), in which they undergo further development in the digestive tract, giving rise after a process of sexual conjugation to a swarm of trypanosomes, which may be inoculated by the mosquito into the owl again.
- III. The large trypanosome (4), the *Leucocytozoon* (5), and the spirochaete (6) belong to a single life-cycle, in which the spirochaetes represent the indifferent multiplicative type, while the large trypanosomes represent the male and female forms. The trypanosomes attach themselves to white cells, and become the *Leucocytozoa*, the gametocytes, which can only develop further in the digestive tract of the mosquito, where they produce gametes, conjugate, and multiply to form a swarm of spirochaetes. The mosquito infects the owl with the parasites in the form of spirochaetes.

These remarkable statements of Schaudinn created a very great sensation. Hitherto the trypanosomes and the malarial parasites had been considered to be widely distinct groups, but Schaudinn's results indicated that they were developmental forms of the same organisms, and must no longer be kept apart in scientific classifications. Further, Schaudinn claimed that the spirochaetes, previously regarded as bacteria, were protozoa identical in structure with the trypanosomes, although he lived long enough to modify these statements considerably. Protozoologists became divided into two camps—the one believing implicitly all Schaudinn's statements and accepting the results that follow from them, the other sceptical as to the truth of his results, or believing that he had fallen into error in his investigations, in spite of his very great reputation and experience in protozoological researches.

In view of the far-reaching consequences of Schaudinn's statements, it is of the utmost importance that his results should be checked, and either confirmed or disproved. Several workers, especially the brothers Sergent, in Algiers, have tried unsuccessfully to obtain the same results. Dr. Woodcock and myself wished* greatly to test the accuracy of data of such fundamental importance in the trypanosome-problem, and we decided to go to Rovigno, where Schaudinn did all his work on the Little Owl, in order to be in a position to repeat exactly his observations.

By the kindness of Dr. Hermes, Director of the Berlin Aquarium and of the Zoological Station at Rovigno, and by the permission of the Prussian Foreign Office, obtained through the British Ambassador at Berlin, work-places and bedrooms in the Zoological Station at Rovigno were placed at our disposal, and we were lodged and boarded in the station very comfortably and at moderate cost. The staff of the station did their best to help and further our researches, and I desire to express our best thanks to Dr. Hermes and his assistants for the kindness and friendliness with which we were received. On the other hand, I regret to say that the results of our expedition were most disappointing. So far from owls being common at Rovigno,

* I may add that we were also urged to take up this investigation by others, e.g., Sir David Bruce, who, after attending one of my lectures last year, suggested to us that we should go to Rovigno and repeat Schaudinn's work. When I applied to Dr. Hermes for leave to prosecute these studies in the Zoological Station at Rovigno, he consulted Dr. Robert Koch, of Berlin, on the matter, as I was informed; and Dr. Koch agreed as to the great importance of setting at rest the uncertainty and controversy produced by Schaudinn's unconfirmed statements.

as we had supposed, they proved to be most difficult to obtain there, especially in the living condition; nearly all those we got were brought to the laboratory dead or dying, by peasants who had shot them. We learnt for the first time, after reaching Rovigno, that Schaudinn himself, though he did his work there, obtained nearly all his birds from dealers in Vienna and elsewhere. By the efforts of Dr. Krumbach, Superintendent of the Station, we procured seven living owls from Vienna and Breslau. During the whole time I was at Rovigno we had altogether nine living owls. Of these, only one showed an infection with trypanosomes, which were found in its bone-marrow after its death, but only *Proteosoma*, *Halteridium*, and *Leucocytozoon* were seen in its blood during life. A few of the other birds showed one or all of the three last-named parasites in the blood, but no trypanosomes in the blood or bone-marrow. With such scanty material we were able to do very little. We made and recorded such observations as it was possible to make, and also put up a great number of preparations for further study. We were considerably handicapped in our work by the great difficulty experienced in keeping owls alive. The weather was exceptionally cold and wintry, and the unfortunate birds died off in captivity in spite of all the care we could take of them. The one owl that showed trypanosomes lived only 48 hours in our keeping. From my visit to Rovigno I learnt, too late, first, that it was not necessary to go so far to obtain *Athene noctua* for study; secondly, that the time of year was ill-chosen. My choice of time was dictated by the fact that my lectures having been fixed for the summer term (May and June), it was necessary for me to return to England at Easter.

I returned to England at Easter, leaving Dr. Woodcock at Rovigno to continue the observations. His report is appended below. Our results are not yet worked out, and until we have had time to go through our preparations, it would be premature to make any statements on the results of our work.

I may add that when material for the study of the parasites of the little owl failed us at Rovigno, we turned our attention to other objects, and we obtained some interesting blood-parasites of frogs and fishes, which we hope to describe when time and opportunity permit.

(c) *Investigations on the blood-parasites of fresh water fishes.*—In my last report I mentioned that I had begun investigations on the trypanosomes and trypanoplasms of fishes in the Norfolk Broads. I continued these studies last summer, in conjunction with Dr. J. D. Thomson, at the Sutton Broad Laboratory, and my best thanks are due to Messrs. Eustace and Robert Gurney for placing the resources of their laboratory at our disposal. While there we studied the blood-parasites of the pike, tench, perch, eel, and rudd, making observations on them in the living condition and putting up permanent preparations for future study. I also made experiments on the transmission of the parasites by means of the fish-louse (*Argulus foliaceus*) and leeches. My experiments with *Argulus* gave, however, purely negative results, and indicate that this Crustacean is not an agent in transmitting the parasite from fish to fish. As regards leeches, the few experiments I carried out were not sufficient to warrant any conclusion being drawn from them. I hope to return to these investigations when a favourable opportunity presents itself.

On my return to London I worked through my preparations and wrote an account of the results I had obtained so far in this subject, in the form of a memoir which was read before the Zoological Society on January 12th, and has since been published in the Proceedings of the Society. In this memoir I described the trypanosomes of the perch, eel, pike, tench, and bream, and the trypanoplasms of the pike, tench, bream, and rudd. Two species of *Trypanoplasma* are described as new, namely, those of the pike and tench, named by me *T. gurneyorum* and *T. keysselitzi* respectively. Preparations of all these forms were made by me by various methods, both "wet" and "dry." As a result I was able to institute a searching comparison between the minute structure of the genera *Trypanosoma* and *Trypanoplasma*, and to show that the nuclear apparatus of both forms is essentially similar, and can be described in uniform terms. My memoir is to be regarded as a general survey of the subject preliminary to the studies on the transmission and development that I hope to carry out at some future time.

With regard to other researches, I stated in my report last year that I had received from Dr. Turnbull, of the London Hospital, preserved tissues of sea trout (*Salmo trutta*) dying of an unknown disease, and that I had found the cause of the disease to be a plentiful infection with parasites of the genus *Ichthyosporidium*. Being unable, under stress of other work, to put the finishing touches to my

investigation of these parasites, I handed over all the material, with my notes, preparations, and drawings, to Miss Robertson, who had already published investigations on another case of infection with this parasite. Miss Robertson, as stated in her report appended below, completed the work and communicated a memoir on it to the Zoological Society.

(2) TEACHING WORK.—I may conveniently divide my teaching work into (a) my formal course of lectures, and (b) informal instruction or help given by me to people working in my laboratory, or by correspondence.

- (a) In the months of May and June of this year I gave a general course of 23 lectures on the Protozoa, on Mondays, Wednesdays, and Fridays, at 5 p.m. Each lecture was followed by an exhibit of microscopic preparations illustrative of the subject of the lecture. The course was similar to that given by me in 1907, the lectures being brought up to date by incorporation into the subject of the many recent advances in our knowledge.

Our collection of preparations has also grown considerably, so that we were able to make the exhibits much more numerous and varied than on the former occasion. The attendance at the lectures averaged about 15, and included principally advanced students of the University and medical men. Owing to the building operations at the Lister Institute, the old lecture-theatre has been dismantled, and the new one was not ready for occupation. My lectures were, therefore, given in a room temporarily fitted up for the purpose. Our chief difficulty in the demonstrations is to get together a sufficient number of microscope-stands. Many of the preparations can only be shown with very high magnification, and our supply of high-power lenses (which are very expensive) is also very limited. To put my Department in a satisfactory condition as regards optical apparatus for teaching and research, a capital grant of at least £200, to be expended solely on microscopes, is urgently needed.

- (b) The following gentlemen have worked in my laboratory or in consultation with me. During my absence at Rovigno, Miss Robertson assisted workers by personal help and attention, while I kept up a correspondence with those who sought advice from me.

Dr. D. J. Reid has been in possession of a place in my laboratory, but has been absent during most of the last six months, owing to ill health. He has been studying the histology of cancer, and has also taken over from me some material sent me from Australia by Dr. J. Burton Cleland (Assistant Director of the Bureau of Micro-Biology, Sydney). The material consists of tissues, preserved in a manner suggested by me to Dr. Cleland, of a diseased fish, the "Milky Barracouta (*Thyrsites atun*), suffering from infection with a Myxosporidian parasite, a species, probably new, of *Chloromyxum*. Dr. Reid is engaged in working out this material with a view to publishing an account of it.

Captain R. McCarrison, I.M.S., to whose studies on goitre and on amoebae parasitic in the human intestine reference was made in my last report, has been working here for about six weeks, and has completed some important researches on the intestinal amoebae. He has communicated to the "Quarterly Journal of Microscopical Science," a memoir, illustrated by a plate, on these amoebae; the work will be published shortly.

Mr. J. S. Dunkerly, Demonstrator of Biology at the Birkbeck College, came to us at the beginning of the year wishing to take up the study of the Flagellata with a view to preparing a thesis for the degree of Doctor of Science of the University of London. By my advice he has studied these organisms so far in a quite general manner in order to acquire a wide knowledge of the whole group and of the various types of form comprised in it before taking up some special line of research.

Mr. R. L. Robinson, formerly a student of Merton College, Oxford, and of the Imperial College of Science, South Kensington, began studies and researches upon free-living Protozoa here, but has been obliged, unfortunately, to put this work on one side for the present in order to concentrate his attention on the medical curriculum.

Dr. W. Cecil Bosanquet, of Charing Cross Hospital, has occupied a place in the laboratory. I suggested to him to take up the study of spirochaetes and handed

over to him some material sent me by Dr. J. Burton Cleland, showing spirochaetes in ulcerative granuloma of the pudenda. Dr. Bosanquet is engaged in the study of these and other spirochaetes.

Mr. J. T. Cunningham, M.A., has been engaged upon some experiments undertaken in order to throw light upon some important and fundamental problems of heredity. He is now continuing the experiments at the Serum Department of the Lister Institute at Elstree.

Dr. H. S. Fremlin, of the Government Lymph Laboratories, has studied Protozoa here in his leisure time, and has consulted me with regard to investigations he is pursuing on the vaccine organism.

Dr. R. Row, of Bombay, sent me slides and preparations of the development in cultures of the parasite of tropical sore (*Leishmania tropica*) with full descriptions of the development. A complete series of figures of the development was drawn by my assistant, Miss Rhodes, from the slides sent to me; and from Dr. Row's letters I put together a memoir on the subject and sent it, together with the figures, to the "Quarterly Journal of Microscopical Science," where it will be published shortly in Dr. Row's name. I also communicated a letter on the subject to the "British Medical Journal."

Colonel Leslie, I.M.S., worked in my laboratory for about a month on Protozoa in general, going through our collection of preparations. We have now got together a fairly extensive and useful collection of Protozoa of all classes which is very helpful for teaching purposes. Additions are continually being made to the collection whenever occasion offers, either by preparations made by myself or my assistants or by gifts from other protozoologists who are working elsewhere.

Professor C. A. Kofoed, of the University of California, came here in June for a short stay, in order to carry on some investigations on contagious epithelioma of fowls.

Dr. C. J. Harrison, of Chelsea, who attended my course of lectures, has also done some work in the laboratory with a view to acquiring some knowledge of technique.

Mr. Duke, of Caius College, Cambridge, and Guy's Hospital, has consulted me with regard to an investigation upon which he is engaged on a Gregarine parasite in a leech, but, owing to the pressure of his medical studies, he has not been able to give as yet any time to work in the laboratory upon it.

Appended will be found (1) Reports by my assistants, Dr. Woodcock, Dr. Thomson, and Miss Robertson, and (2) a list of papers published from this Department during the year covered by this report.

E. A. MINCHIN.

REPORT of Dr. H. M. WOODCOCK, D.Sc. Lond., Assistant to the Professor of Protozoology, for the year ending June 30th, 1909.

My work during the past year falls mainly under the heading of "Research." I assisted the Professor in the routine work of the Protozoological Laboratory at the Lister Institute during the autumn and early winter of 1908, as required, but, owing to my absence from England during the whole of this spring and early summer, I was unable to give assistance this session in preparing and arranging the exhibits and demonstrations given in connection with the course of lectures on Protozoa, as I have done in previous years.

My research work may be considered under two main headings:—

(a) The continuation of the investigations on the Haematozoa of common English birds, *e.g.*, the chaffinch and redpoll;

(b) The study (more correctly the re-investigation) of the life-histories of the Haematozoa of the Little Owl (*Athene noctua*).

(a) Continuing my researches on the Protozoan blood-parasites (*Trypanosoma* and *Halteridium*) of the chaffinch and redpoll, I obtained in the autumn some interesting and important results by the tedious process of searching systematically through the permanent preparations that I had made of the blood of these birds.

Since I had made arrangements to leave England with Professor Minchin, and, consequently, knew that I should not have for some time the opportunity to complete my detailed account of the whole research, it seemed to me worth while to publish a short note* relating to these results, of which the following is a brief summary.

The material was furnished by a chaffinch which had been found to be infected with trypanosomes, and which subsequently developed a heavy infection with *Halteridium* also, although the latter parasite had never been noticed previously in the blood. The bird had been kept in captivity for two or three months and could not have become infected with *Halteridia* during that time. All the preparations, it should be noted, were made in the night-time between 1 and 3 a.m. The *Halteridia* were very numerous, and I anticipated little or no difficulty in finding various stages in the transition from the active trypaniform phase of the parasite to the resting intracellular or halteridial phase and *vice versa*, on the supposition that the connection between these two forms asserted by Schaudinn to exist in the case of the parasites of the Little Owl exists in this case also.

A general examination of the more likely preparations, including smears from the bone-marrow, showed, however, no indications of any such transition. *Halteridia* of all sizes were to be found in the red blood corpuscles, from very minute oval or pear-shaped forms, 2μ or less in diameter, up to the large full-grown individuals. Many different phases can often be seen in a few fields of the oil-immersion lens, particularly in liver smears. A noteworthy point is that in smears made immediately after drawing the blood, before the ripe gametocytes have had time to become liberated from the corpuscles, no free forms whatever are to be found. Hence, so far as I can say at present, it would appear that in the case of the *Halteridia* parasitic in the chaffinch, the young individuals after penetrating a blood-corpuscle do not leave it until fully grown; in other words, that in this case there is no alternation between free phases and intracorpuseular phases during the growth of the *Halteridium*. Another interesting point is that, in spite of the large number of minute individuals present in the blood, I never saw the least sign of endogenous multiplication (schizogony) in any of the full-grown individuals; that is to say, nothing approaching the fragmentation of the nucleus and segmentation of the cytoplasm at the two ends of the body, alleged by Labbé to occur. I feel sure that the small *Halteridia* do not arise by division of the large forms. The most important point ascertained by me is that many of the *Halteridia* exhibit in regard to their nuclear apparatus a condition which may be termed *nuclear dimorphism*. By this phrase is meant a characteristic separation of the nuclear material into two constituents: a larger body, the trophonucleus, and a smaller body, or kintonucleus. These two nuclei are of regular occurrence in trypanosomes and other parasitic Flagellates, and in the resting condition of these organisms they are always situated very close together, often actually in contact. Two such bodies were stated by Schaudinn to be present, closely associated, both in the *Halteridium* of the Little Owl and in another parasite (*Leucocytozoon ziemanni*), which occurs in the white blood-corpuscles of the same bird.

The nuclear dimorphism was first observed by me in some of the large female individuals. Lying close beside the ordinary nucleus, generally (but not always) in contact with it, is a much smaller body which stains much more deeply than the larger one. There is no possibility of confusing this small nuclear element with a pigment-grain. In the parasites of indifferent type, which are of much rarer occurrence, this kintonuclear body is often much larger, and may approximate in size to the other nucleus. Nuclear dimorphism of this kind can also be recognised in some of the small forms, and this feature gives such individuals a striking resemblance to the resting phases described of various Herpetomonadine parasites. Up to the present I have not been able to make out a distinct kintonuclear body in any of the male forms examined. This may be because it is not differentiated, as a compact organella, from the rest of the diffuse nucleus of this type. Moreover, in many of the female individuals also the kintonuclear element is not prominent or separate. It is quite probable that at times the two constituents are incorporated in one nucleus, as was said by Schaudinn to occur at certain periods.

I have endeavoured to find some phases showing an actual transition from a *Halteridium*-form to a trypanosome-form. If they occur, such phases must be

* The note appeared in the "Quarterly Journal of Microscopical Science," vol. 53, January, 1909, p. 339.

very few and far between. This is, indeed, only what might be expected from the comparative scarcity of the trypanosomes themselves. I have only found one phase which may be regarded as transitional between the two forms, but I attach, nevertheless, considerable importance to this phase, since the most reasonable explanation of it that can be offered is that it represents an early stage in the development of a flagellum, as described by Schaudinn; in fact, I do not know what other explanation of it to suggest.

As regards next the trypanosomes of the chaffinch, I found certain indications which, so far as they go, also point to an ontogenetic relation between the trypanosomes and the *Halteridia*, or at least can be explained on the assumption that such a relation exists. In my series of slides, chiefly in smears of the bone-marrow, there were found a few very small trypanosomes, which were not larger than the largest specimens of *Halteridium*. When these small trypanosomes were compared with the large ones in the blood at this time, the difference in size was seen to be very marked. Between these extremes of size, however, all intermediate stages were to be found. A series of regular gradations from the smallest to the largest trypanosomes could be figured. In no case, however, were dividing forms seen, even at this time of the year, when the trypanosomes were of more frequent occurrence than at other seasons, for instance, the spring. Hence I consider that the large trypanosomes were derived from the small ones by growth simply and not that the small trypanosomes had originated from large forms by fission. At the time I was strongly disposed to regard the smallest trypanosomes as having arisen from certain of the adult *Halteridia*, namely, from the scantily-occurring indifferent or neuter individuals. Unfortunately, I have not seen anything to strengthen this view while at Rovigno.

It is certainly highly significant that, up to the present, when an intracellular parasite has been known to exhibit nuclear dimorphism, although lacking at that stage any flagellum or obvious sign of flagellate affinity, it has been found subsequently to be really a phase in the life-cycle of some flagellate form; in other words, the knowledge of nuclear dimorphism in a Protozoan parasite has hitherto heralded the discovery of its ontogenetic connection with a Flagellate. Nevertheless, since working at Rovigno, I have begun to think it probable that an intracellular parasite may exhibit *nuclear* dimorphism as the result of a *phylogenetic* relationship with a Flagellate, without being necessarily ontogenetically connected with one. An illustration of this is seen in the parasite of the Little Owl, *Leucocytozoon ziemanni*; this form certainly shows the same characteristic nuclear dimorphism as is to be found in *Halteridium*, whatever the stain used, and, in this case, the separation of the two nuclear constituents seems to be more usual than in the case of *Halteridium*. In most of the female forms, but less frequently among the male forms, a smaller nuclear body, of dense texture and staining deeply, occurs together with the larger, pale, and more diffuse nucleus. Usually the smaller element lies at one side of, and in contact with, the larger one; but now and then it is distinctly separate from it. By the kindness of a colleague, Dr. Reichenow, of the Kaiserliche Gesundheitsamt, Berlin, who is at present working here in Rovigno, I have been able to compare the nucleus of *Halteridium* with that of certain Haemogregarines (parasitic in the red blood-corpuscles of the lizard and the tortoise). When the parasites are stained by the same method (preferably haematoxylin in some form), the *Halteridium*-nucleus is seen to be of a type quite different from that of the Haemogregarines, and to present a marked resemblance to the nucleus of a Trypanosome. But neither in the case of the *Halteridium* nor of the *Leucocytozoon* of the Little Owl have I observed up to the present any conclusive indications of the actual transformation into a trypaniform condition. This brings me to a consideration of the work done at Rovigno.

(b) The investigation of the life-history of the Haematozoa of the Little Owl has been carried on, up to the present, at the Zoological Station at Rovigno (Istria), the actual place where Schaudinn himself carried on his studies on these parasites, this condition being of great importance, according to some of his critics. I may add that I have been able to defray the expenses of the long journey to Rovigno and of a stay of several months at the Zoological Station there, solely by the help of the grant of a Mackinnon Studentship awarded to me by the Royal Society. Besides studying the parasites of the Little Owl, attention has been paid incidentally to the blood-parasites of certain other animals occurring at Rovigno, *e.g.* fishes, frogs, and birds, as occasion was afforded. My research at Rovigno has been

carried out in collaboration with Professor Minchin, who has explained in his report the special reasons for undertaking these investigations; he has also given an account of the progress of our joint work up to the time when he was obliged to return to England in order to give his course of lectures, so that I may confine myself to an account of the results achieved since that time up to the present.

With regard, first of all, to a few important points noted concerning the parasites in the bird. In three owls (Nos. 11, 17, and 20), in which *Leucocytozoon* was present in the peripheral blood but *Halteridium* was not found, no trypanosomes were found. The bone-marrow of Nos. 17 and 20 was exhaustively searched, and it may be said with practical certainty that no free trypanosomes were present. In the case of another owl (No. 19), in which *Halteridium* was very numerous (*Leucocytozoon* being also present), trypanosomes as such were also entirely absent, the bone-marrow being *thoroughly* searched. Some very important observations were made in the case of another owl (No. 23), which showed the strongest Halteridial infection which came under our notice, there being often as many as five or six parasites in one corpuscle, while very few corpuscles were free from infection. The blood was twice examined during the night-time without any very minute trypanosomes being seen, although small *Halteridia* of various sizes were occasionally seen free. (By the phrase "very minute trypanosomes" is meant individuals which are about equal in bulk to very young *Halteridia*.) The free *Halteridia* did not undergo any changes while under observation. In the permanent preparations that were made from this case, small free *Halteridia* were not infrequent in occurrence, but, so far as the slides have been examined up to the present, none have been found showing trypaniform characters. Thus the *Halteridium* parasitic in the little owl exhibits a difference from that parasitic in the chaffinch, in so far that young growing individuals of the parasite are found free (*see above*).

A most important fact, with regard to owl No. 23, is that on each occasion that an examination was made by night (but never in examinations made by day), a single small trypanosome was seen in the peripheral blood, one such parasite being found each time in one of two wet films made under a coverslip. The two trypanosomes in question agreed in type with the small forms noted in the bone-marrow, and, inclusive of the flagellum, each trypanosome was only a trifle longer than the length of a red blood-corpuscle, and in bulk at least as large as the largest adult *Halteridia*. This is the first time we have found a trypanosome free in the peripheral blood of the owl, and it is a very significant observation, in view of the results gained in connection with the experiments on mosquitoes, which have proved much more satisfactory in the case of the owl and its parasites than in the case of the chaffinch.

At first, at the beginning of the season, from the middle to the end of May, all attempts to induce bred-out mosquitoes to bite were fruitless. Mosquitoes caught "wild" were then tried, and after two or three endeavours a few were persuaded, at the beginning of June, to take blood from an owl infected with *Halteridium*. In one mosquito, examined 36 hours after it had fed on the owl, the fluid of the stomach was found to contain both oökinetes of *Halteridium* in various phases and active trypaniform flagellates. The all-important question was whether these two types of parasite were connected. Oökinetes were kept under observation for some hours, but did not become trypaniform. With regard to this point, I will only mention here that in the permanent preparations that were made many of the oökinetes show very interesting nuclear changes, involving the formation of two separate nuclear bodies. Until, however, time has been found for the systematic study of the slides, it is not possible to make statements concerning the further development of the oökinetes.

On the other hand, with regard to the flagellates found in the mosquitoes, the possibility had to be taken into account that they might have been already present in the mosquito before it sucked the blood of the infected owl. In order to ascertain how far this supposition was likely to be correct, mosquitoes caught wild were allowed to bite an owl free from infection, and then examined after varying intervals. As a result of this line of investigation it was found that a small number of the "wild" mosquitoes had their alimentary canal infected with flagellates; hence the only safe course was to make use of bred-out mosquitoes.

Fortunately since the middle of June no difficulty has been experienced in getting some, if only a few, of the mosquitoes reared in captivity to feed, when left all night with an owl. In a large percentage of the mosquitoes allowed to bite the

owl (No. 23), referred to above, in which *Halteridium* was abundant and in which trypanosomes were known to occur at night in the peripheral blood, active trypaniform flagellates were subsequently found. As a control experiment, bred-out mosquitoes were left for the night with an owl free from infection, and in no instance have active flagellates been found subsequently in these mosquitoes when examined at various intervals of time after they had taken blood. Hence it would seem to be practically certain that the flagellates seen in the former case came from the infected owl.

Another point of considerable interest is to be noted. The various types of form found in the mosquito show a close resemblance to those I obtained in cultures of the trypanosomes of the chaffinch and redpoll. In both cases the typical "trypanomonad" form, which I described in my last report, is found, and this type does not occur in the insectan flagellates, which are of a "Herpetomonad" type, and are probably not connected with a Trypanosome of a vertebrate. Moreover, the remarkably long, attenuated forms, with a characteristic ladder-like nucleus, which I found on two or three occasions in my cultures, are of not infrequent occurrence in the mosquito. This type has only been found in a very few cases (*e.g.*, by Stuhlmann in *T. brucei* in *Glossina fusca*, and by Miss Robertson in *T. raiae* in the leech *Pontobdella*), and there can be no doubt that it represents a phase of particular importance in that part of the life-cycle of a trypanosome from the blood of a vertebrate which is undergone in the invertebrate host.

In conclusion, although the ontogenetic connection of *Trypanosoma* and *Halteridium* still remains doubtful, one thing can be said with certainty, namely, that the contention of several workers, *e.g.*, Novy, McNeal, and others, that the flagellates found in mosquitoes are entirely and solely parasites of the insect itself, and have nothing to do with the trypanosomes of vertebrates, is incorrect. It may very well be, on the contrary, that many of the flagellates occurring in "wild" mosquitoes are really phases in the life-cycle of avian (or other vertebrate) parasites.

H. M. WOODCOCK.

Rovigno,

June 28th, 1909.

REPORT of Miss MURIEL ROBERTSON, M.A., Assistant to the University Professor of Protozoology, for the six months ending June 30th, 1909.

I.—RESEARCH.

During the last six months I have had the opportunity of continuing my work upon *Trypanosoma raiae*. This trypanosome is a very large form parasitic in the blood of the skate. About 50 per cent. of the skates in the Clyde area show the parasite in their blood. The transmitting host is a marine leech, *Pontobdella muricata*. In an earlier memoir I described a number of the stages of the parasite as it appeared in *Pontobdella*, but never had the opportunity of coming across the earliest stages. This year I was so fortunate as to obtain these stages in some young leeches which had fed for the first time. I was also able to confirm these observations by letting skate's blood containing trypanosomes stand on a sealed slide; it was then seen that the stages obtained in this way corresponded exactly with the early stages found in the leech.

The course of infection is briefly as follows. The blood of the skate, with the contained trypanosomes, is drawn up into the crop of the leech when it sucks blood. The trypanosome rounds itself off, loses its membrane and its flagellum, and comes to rest in an approximately spherical shape. This occurs in the first 12 hours; after this a number of divisions take place at intervals of about 8 to 16 hours. After about 3 or 4 days, some of the products of these divisions develop a flagellum at the anterior end. The parasite at this stage has no undulating membrane; the kinetonucleus lies in front of the trophonucleus; and the flagellum projects straight forwards. The organism gradually develops into a typical trypanosome by the lengthening of the body, the travelling backwards of the kinetonucleus, and the development of an undulating membrane. The parasites seem to quit the crop of the leech after a time, and are found in greater quantities in the intestine, where they multiply rapidly, giving rise to an immense number of individuals which show great

variability in size and shape. This condition lasts for many months in the leech, but finally very slender forms of the parasite are produced which do not multiply by division. At the close of digestion the slender forms pass forwards along the crop into the region of the proboscis. I am inclined to think that the slender forms of the parasite are inoculated into the skate when the leech next feeds.

My recent work on *Pontobdella* afforded me the opportunity of working through a number of stages again, using throughout "wet" methods of technique. I was thus able to criticise, and in some cases correct, my earlier work, which had been carried out with "dry" methods, and the use of the Giemsa stain. The result of this work is about to be published in the "Quarterly Journal of Microscopical Science."

At the request of Professor Minchin I wrote a short paper on the Ichthyosporidian parasite of the sea trout, the greater part of which was drawn from the notes and drawings previously made by Professor Minchin and Dr. Turnbull. This parasite is a small multinucleate form which invades the tissues of practically every organ of the fish, and finally causes the death of the host. It is a little-known parasite, though widely distributed. I had found it in 1906 in a flounder from the Clyde area, and have recently been sent haddocks from Aberdeen in which an immense number of the parasites occurred in the muscular tissue. The case of the haddocks was observed by the fishmonger, who noticed the minute granules, each a cyst of the parasite, while cutting up the fish into fillets. It is, of course, a matter of considerable importance that a parasite of so dangerous a character, and of such wide distribution amongst food-fishes, should be properly investigated. At present nothing is known of the method of infection, and only the most fragmentary information as to the life-cycle can be obtained from the material investigated. It is to be hoped that further opportunity may arise for the investigation of this parasite. In the fish it occurs as a multinucleate organism contained within an envelope. It is capable of quitting the envelope and of creeping through the tissues. It multiplies by breaking up into a number of small forms, and also by a process known as "plasmotomy," i.e., a process of fission whereby a multinucleate mass of protoplasm breaks off from the main body of the parasite.

My paper on this *Ichthyosporidium* has been read before the Zoological Society, and will appear shortly in the Proceedings of the Society.

A short preliminary note on some investigations on certain flagellates parasitic in the intestine of the common fowl, undertaken in collaboration with Mr. C. H. Martin, B.A., has been communicated to the Royal Society for publication in the Proceedings. Further work upon these interesting forms is at present in progress. The importance of obtaining information concerning the intestinal parasites of domestic animals needs no emphasizing. The form to which most attention is being devoted by us is a *Trichomonas*, which was formerly described, but incorrectly, as a trypanosome under the name of *Trypanosoma eberthi*. Other species of *Trichomonas* are parasitic in various mammals, including man. Their life-history, however, is more easily worked out in birds than in any other hosts.

In addition to the investigations already mentioned, I am continuing my studies upon the Haemogregarines and other blood-inhabiting parasites which I brought back with me from Ceylon. These include a species of *Haemocystidium* from the Tree-Gecko (*Hemidactylus leschenaulti*), Haemogregarines from snakes, geckoes, and tortoises, and trypanosomes from geckoes and from the milk-tortoise (*Emyda vittata*). The endogenous cycle has now been made out in three Haemogregarines, namely, in those parasitic in the rat-snake, the common lake-tortoise (*Nicoria trijuga*), and in the milk-tortoise, respectively. Stages of the last-mentioned parasite have been obtained in the alimentary canal of two leeches which are parasitic on the respective hosts, and I am in hopes that I may obtain the more important stages of the life-cycle of these Haemogregarines.

II.—DEPARTMENTAL WORK.

I have assisted Professor Minchin in the general work of the laboratory, and during his absence in Rovigno I had charge of the routine of the department. This included such attention as the various researches required. During the summer term much time was taken up by assisting in the preparation of the demonstrations illustrating the lectures. The difficulty of preparing a satisfactory series of exhibits was much increased by the small number of microscope-stands available,

and much time was wasted and ingenuity expended in making old stands (borrowed from various departments in the Lister Institute) serve the required purpose. I also made a certain number of preparations for the slide-cabinet, and assisted workers who wished to acquire the technique of protozoan work.

MURIEL ROBERTSON.

REPORT of Dr. J. D. THOMSON, Assistant to the Professor of Protozoology, for the six months ending December 31st, 1908.

I resigned my post as assistant to Professor Minchin at the end of 1908 on leaving for Ceylon. During the six months covered by this Report I worked chiefly at the experimental treatment of trypanosomiasis in collaboration with Professor Cushny and under the supervision of a Sub-committee of the Royal Society. The results of this work are embodied in a report submitted to that Sub-committee and were published in the Report of the Advisory Committee for the Tropical Diseases Research Fund for the year 1908 [Cd. 4476] pages 18-22.

In addition to this, I assisted Professor Minchin in his researches on *Trypanosoma lewisi*, and also continued my investigations on the *Leucocytozoon* of the common rat. The whole life-history of this parasite has meanwhile been worked out by W. W. Miller and published in Bulletin No. 40 of the Hygienic Laboratory, Washington. Miller gives the parasite the name *Hepatozoon perniciosum*, and finds the invertebrate host to be the rat-mite (*Lelaps echidninus*). The infection is contracted by the rat when it eats a mite containing ripe sporozoites. This peculiar mode of infection, though interesting in itself, and adding to our knowledge of possible modes of infection by parasitic Protozoa, nevertheless tends to lessen our interest in the parasite when viewed from the standpoint of human pathology since human beings are not likely to be infected to any large extent in this manner. It has been suggested by Miller that the disease might be employed usefully in the extermination of wild rats, but the fact that the disease is so frequently found in wild rats in this country points rather to the wild rat being a "reservoir" host for this parasite and the possible source of the epizootic amongst tame rats which furnished Miller with the opportunity of investigating the life-history of the parasite. Although so deadly to tame rats it is probable that "*Hepatozoon*" is comparatively innocuous to wild rats.

J. D. THOMSON.

LIST of PAPERS published from the Department of Protozoology during the year ending June 30th, 1909.

By Professor E. A. Minchin:—

- (1) Note on the Polymorphism of *Trypanosoma gambiense*. "Parasitology," Vol. I., pages 236, 237, plate XVII.
- (2) Observations on the Flagellates parasitic in the blood of Freshwater Fishes.
"Proc. Zool. Soc.," London, 1909, pages 2-31, plates I.-V.

By Dr. H. M. Woodcock:—

- (3) On the occurrence of Nuclear Dimorphism in a *Halteridium* parasitic in the Chaffinch.
"Quarterly Journal of Microscopical Science," Vol. 53, pages 339-349, 14 text figures.
- (4) Protozoa.
"Zoological Record for the year 1907": Int. Cat. Sci. Lit., December, 1908.

Copies of (1), (2), and (3) are enclosed herewith.*

* Not reprinted.

APPENDIX IV.

REPORT ON WORK OF QUICK LABORATORY.

PROFESSOR G. H. F. NUTTALL to COLONIAL OFFICE.

(Received 6 October, 1909.)

SIRS,

3, Cranmer Road, Cambridge, October 2nd, 1909.

I DESIRE to apply for a renewal of the grant of £100 a year for two years towards the expenses of the Quick Laboratory in Cambridge. At the same time I beg to apply for the renewal of the grant of £100 per annum toward the studentship in medical entomology.

The enclosed lists of publications* will indicate the character of the work which has been carried on in the laboratory during the three years ending September 30th. The main results of our investigations may be stated as follows:—

Report for 1909.

Together with Dr. Hadwen, a remedy has been discovered for malignant jaundice in dogs and redwater in cattle, neither of which diseases has hitherto been affected by any form of treatment known. Our investigations have, in addition, thrown fresh light upon the biology of the parasite. At present the remedy is being tried officially in various parts of the world—East and South Africa, India, the United States, Italy, Germany, Russia, and Great Britain.

Together with Dr. Graham-Smith we have made studies upon the parasite of East Coast fever, and further investigations thereon, in conjunction with Dr. Fantham and Miss Porter, will shortly be published. Further investigations have been carried on upon canine piroplasmiasis by Dr. Graham-Smith and myself.

Investigations have been conducted with regard to the part played by flies in the dissemination of infective diseases, the work being conducted by myself in conjunction with Dr. Graham-Smith and Mr. Jepson.

Dr. Fantham and Miss Porter have reported to the Royal Society upon investigations relating to spirochaetes, and the former has been aiding in the work of the Grouse Commission, especially as protozoologist.

Mr. Warburton and myself have been continuing the work on ticks, and have described several new species from different parts of the world, besides being engaged in the preparation of the forthcoming parts of our book on the ticks of the world, in conjunction with Messrs. Cooper and Robinson. In addition, Mr. Warburton has made valuable observations upon that world-wide parasite, the body-louse of man.

Mr. Strickland has been studying the flagellates of fleas and other blood-sucking animals.

Captain Patton, Indian Medical Service, also conducted interesting observations on protozoa in this laboratory. These have been published, as will be seen from the accompanying bibliography.

Dr. G. Udale Smith has worked in the laboratory upon relapsing fever in man, and published his results in the form of a Doctor's Dissertation (London).

With regard to Mr. Jepson, I would state that he has resigned the studentship in medical entomology and gone to the Fiji Islands as entomologist to conduct temporary investigations into the damage caused by certain insects to cocoanut plantations in those islands. I am, with the consent of the Vice-Chancellor, appointing Mr. Gordon Merriman as his successor. Mr. Jepson carried on investigations upon the structure of the bed-bug and upon the house-fly, which is as much of a pest in other parts of the world as it is in this country, and provedly an important disseminator of disease. In addition, he has helped very materially in ordering and classifying the collections of blood-sucking arthropods received from various parts of the world. Mr. Merriman, who has been here since the end of July, and is only about to be appointed to the studentship, has taken up the work on the bed-bug, and is working upon the biology and structure of *Ornithodoros moubata*. Besides this, he has helped in the ordering and classifying of the blood-sucking arthropods which continue to reach us from all parts of the world.

The grant obtained from the Tropical Diseases Research Fund has been of material assistance in furthering the work of the Quick Laboratory, and I trust that the Advisory Committee will see fit to renew it.

I remain, &c.,

G. H. F. NUTTALL.

* Not printed.

APPENDIX V.

REPORTS FROM THE LONDON SCHOOL OF TROPICAL MEDICINE.

No. 1.

LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 10 May, 1909.)

Dreadnought Hospital, Greenwich, S.E.,

SIR, 7th May, 1909.
I HAVE the honour to enclose herewith, for the information of the Tropical Diseases Research Fund Committee, the half-yearly reports from the following Departments of the London School of Tropical Medicine:—

Arthropodology—Colonel A. Alcock, I.M.S., C.I.E., F.R.S.

Helminthology—R. T. Leiper, M.B., Ch.B., F.Z.S.,

Protozoology—C. M. Wenyon, B.Sc., M.B., B.S.,

together with a paper* entitled "A trypanosome and hæmogregarine of a tropical American Snake," and a copy of the syllabus* of the course in protozoology, &c.

I am, &c.,

P. MICHELLI,

Secretary.

Enclosure 1 in No. 1.

London School of Tropical Medicine, Royal Albert Dock, E.,

16th April, 1909.

Report of the Arthropodologist, 1st November, 1908, to 15th April, 1909.

I have the honour to present my report for the half-year ending 15th April, 1909.

My time has been employed (a) in naming and arranging the collections, (b) in teaching.

1. In December last I represented that the time allotted to me for teaching was inadequate. The matter was considered at a special meeting of the school staff, and it was decided that in addition to the ordinary course of lectures and demonstrations, advanced classes should be instituted for students who aim at a higher standard.

2. Towards the collections material has been received from the following places and persons:—

(a) Africa : Soudan, and Uganda : Arthropods of various kinds, and leeches from Drs. H. Bayon, J. B. Christopherson, and L. Sells. Sierra Leone : Flies and venomous snakes, from Drs. H. E. Arbuckle, D. Burroughs, and J. S. Pearson. Gold Coast : Flies, from Dr. W. M. Graham. Northern Nigeria : Flies, from Dr. J. M. Pollard. North-Eastern Rhodesia : Specimens of *Glossina palpalis*, from Dr. Spillane.

(b) America : A fine series of venomous snakes, presented by the United States National Museum.

(c) Asia : Calcutta : Mosquitos from the Indian Museum; rat-fleas from Dr. H. M. Crake. Madras : Flies from Captain W. S. Patton, mosquitos and ticks from Dr. W. Woolliscroft. Kelantan : Mosquitos and snakes from Dr. J. D. Gimlette. Sarawak : Flies from Dr. A. R. Wellington.

In addition must be mentioned two beautifully articulated snake skulls presented by Dr. L. W. Sambon.

3. Some specimens of the commoner species of *Glossina* have been given to the Indian Museum, and a few examples of blood-sucking flies have been given to Fleet-Surgeon P. W. Bassett-Smith, of the Royal Naval Hospital.

4. The reference collection of select specimens of authentically-named species is steadily increasing. On the special arthropod side it now includes all the admitted

* Not reprinted.

species of *Glossina*, except *longipennis*; a very fair number of *Culicidæ* and *Tabanidæ* from Africa, from the Oriental Region, and from South America; and a good series of African and Oriental ticks; on the general side the chief feature is a fine series of venomous snakes in which every great region of the world, except Australia, is represented.

5. The teaching collection has been advanced. It includes (a) a set of "index" trays representing important Dipterous families, important Culicid genera and species, and important genera of parasitic and blood-sucking flies other than Culicids; (b) over 100 tubes of named and mounted specimens of Arthropoda for students to handle and study at their convenience; (c) about 400 microscope slides of all the more important groups of Arthropoda for circulation among students; and (d) a good series of named preparations of snakes.

6. Teaching. In each of the two sessions included in the half-year I gave the usual courses of lectures and demonstrations on Arthropoda and Thanatophidia. I also gave individual attention to five special students working independent of the class.

7. Miscellaneous. Information and assistance has been given to several correspondents and visitors. In March I served on a deputation to the East Ham Council of which the object was to advocate the destruction of the house refuse that at present in the neighbourhood of the school is allowed to accumulate and form a vast nursing ground for house flies. I also attended a Conference which was held at the Colonial Office to discuss certain proposals for medico-entomological research in some of the African Colonies.

At the request of Professor Nuttall the school collection of the genus *Hæmaphysalis* has been sent to Cambridge for examination in connection with the "Monograph of Ixodoidæ" now in preparation by Professor Nuttall and his collaborators.

A. ALCOCK,

Lieutenant-Colonel, I.M.S., retired.

April 15th, 1909.

Enclosure 2 in No. 1.

London School of Tropical Medicine, Royal Albert Dock, E.,

1st May, 1909.

Report of the Helminthologist for the half-year ending 1st of May, 1909.

I have the honour to submit my report upon the work of the Helminthological Department of the London School of Tropical Medicine for the half-year ending 1st May, 1909, and to forward reprint of a paper, entitled "*Filaria volvulus*, Leuckart—its Structure, Pathology, and Geographical Distribution," by Dr. A. C. Parsons, upon work done in the laboratory during that period.

Teaching.

Four systematic lectures and a laboratory course extending over three weeks were given by me in December, and again in March as part of the usual school course in tropical medicine.

Advanced Workers.

Dr. Arbuckle (Sierra Leone, Colonial Medical Service), occupied a table in the research laboratory for a period of two weeks, and made a detailed study of human helminthes that occur in Africa. Dr. A. C. Parsons (Northern Nigeria Colonial Medical Service) was afforded similar accommodation, and devoted his attention to investigation of some material obtained from six cases of *Filaria volvulus* that had been surgically treated by him in the execution of his official duties in Northern Nigeria. The results of Dr. Parson's work have recently been published in "Parasitology." His paper contributes considerably to our knowledge of the structure of this human parasite. It also confirms and amplifies previous observations on the pathology and geographical distribution of the disease.

Arrangements for advanced tuition in Helminthology.

Enquiries have been received from time to time from students who have already passed through the ordinary school curriculum for further instruction in the various

branches of tropical parasitology. The School Committee have instituted an advanced course in medical zoology to meet this demand.

The course will be of twelve weeks' duration, and the last three weeks will be devoted to helminthology (including leeches). In this subject the teaching will consist almost exclusively of practical work in the research laboratory under the supervision of the helminthologist. The structure and development of the more important human helminthes, already considered in the ordinary course, will be restudied in detail. Many of the rarer parasites will also be examined. Considerable attention will be given to methods of collecting and preserving the various kinds of worms, and for this purpose occasional visits will be made to abattoirs. By examining the material there obtained the student will review many parasites of the domesticated animals, a considerable number of which are of importance from the economic standpoint as well as from their close relationship to those infesting men. The identification of the various species will be made to serve also as an introduction to general helminthological literature, the most easily accessible sources to which will be explained; the object of the courses being, briefly, to provide a sufficient ground work of practical training to enable those proceeding to the tropics to pursue further investigation unassisted.

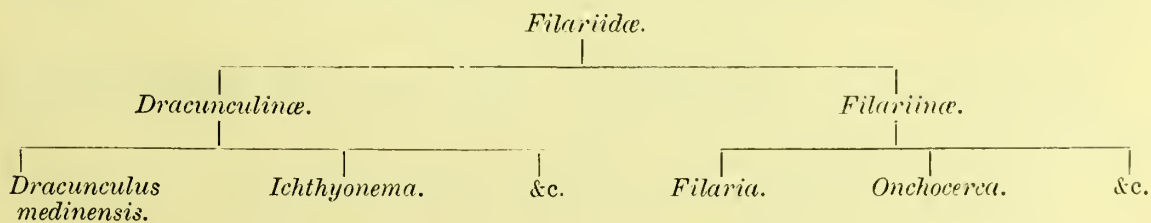
Original Investigations.

Several large collections of helminthes have been received from various foreign sources, and preliminary reports have been forwarded to the collectors. Most of the species were, of course, known to science, but in every case they well repaid examination, and formed welcome additions to the Museum.

Dr. Graham (Gold Coast) sent a fine series of parasites from rats destroyed during the plague investigations at Accra. Dr. Stanton (Malay States) contributed a large number of forms, mainly from the domesticated animals of the Malay States; a few round worms from other hosts included a new *Echinorhynchus* from the cobra. A consignment, by Dr. Pearson, from the Congo, included a new genus of nematode belonging to the family Spiruridæ. Dr. Sells and Dr. Bayon, collecting in different parts of Uganda, both sent several novelties, the latter finding a new species of *Ceratospira* in the vulture, and a very remarkable trematode showing the peculiar branching of the gut that characterises alone the genus *Fasciola*, but distinguished therefrom by many other features, such as compactness of the testes and ovary, position of the genital openings and chamber-like distension of the uterus, that will undoubtedly necessitate the creation of a distinct genus. Mr. Foy forwarded a large quantity of nematodes from the horses of Northern Nigeria. These miscellaneous collections throw much light on the nature of the parasites infecting domesticated animals in our tropical dependencies.

A considerable amount of time has been devoted to the study of the structure and relationships of *Filaria* worms with special reference to the human forms—*Dracunculus medinensis* and *Filaria volvulus*. The genus *Filaria* is, as we at present know it, little more than a collective group of connective tissue parasites of "Filari-form" appearance. It composes a large number of forms that differ from one another markedly in internal structure and life-history, and the grouping of these diverse forms into a single genus is gravely misleading.

From a study of the internal anatomy of the guinea worm and similar forms, I have been led, I believe, to the correct understanding of its anomalous position in the genus. In my opinion the guinea worm shows many similarities in structure and life history with the genus *Ichthyonema*, and with it can only be brought into true systematic relationship with the genus *Filaria* as a member of a distinct genus and subfamily of the family Filariidæ.



In these investigations I have been much assisted by the study of a new form, closely allied to the *Dracunculus medinensis*, that occurs in the Indian alligator.

The comparative study of the internal anatomy of the other species of human

Filariæ and of those infesting the lower animals will doubtless lead in the near future to the grouping of many of the human "Filaria" into other genera. The necessity for the transference of *Filaria volvulus* became evident during a recent study of its internal anatomy. It occurred to me to compare with it the *Spiroptera reticulata* of horses, on account of the marked similarity in structure in the worms themselves. Instead of *reticulata* and *volvulus* being, respectively, uncongenial species of *Spiroptera* and *Filaria*, they form very closely-allied species of the same genus, viz., *Onchocerca*. The importance of this conclusion lies in the fact that whereas *Onchocerca volvulus* is a parasite of man in certain limited regions of tropical Africa, and, therefore, difficult to investigate regarding its life history and intermediary host, *Onchocerca reticulata* is, on the other hand, a common parasite of horses in certain parts of Europe, and one that on account of its economic importance is attracting a good deal of attention; a considerable amount of work has already been done, and investigations are now in actual progress on the Continent regarding its mode of dissemination. Whatever results are obtained upon the life history and intermediate host of *Onchocerca reticulata* may with confidence be used as valuable information in any future enquiry into the etiology of *Onchocerca volvulus* owing to the close relationship we have established to exist between these two forms.

The results, together with anatomical detail of these and other filarial worms, remain still to be embodied in a formal publication.

Another group to which some attention has been devoted during the past six months is the trematode family Paramphistomidæ. A large number of the known species of this group have been studied in serial sections—a matter involving very considerable labour. The structural details of several of Cobbold's species inquirendæ have been studied, and these forms can now be placed in their correct systematic position. Four species new to science have been determined from the collections made by me in Africa. These results are in course of preparation for the Press.

Through the kindness of Dr. A. E. Shipley, who has supplied me with material, I have been able to study the development of the genus *Trichostrongylus*, three species of which are known to occur as human parasites in Africa. The life cycle, outside the body, corresponds closely with that of the hook worm *Ankylostomum duodenale*. I also continued, during the residence of the patient in the Seamen's Hospital, my studies of the development of *Anguillula intestinalis*. These observations have led me to doubt in some measure the entire correctness of the early conclusions mentioned in my previous report. It may be recalled that in that report I gave a preliminary note upon the culture of adult and embryonic forms in fæces received from a patient in the wards suffering from Anguilluliasis. These adults continued to reproduce for several generations. Although I have made many similar cultures since, these have been uniformly unsuccessful.

A very close microscopical scrutiny of the "cultured" worms revealed certain very minute, but constant, differences, that incline me to doubt if the parasite really belongs to the same species as *Anguillula intestinalis*. The possibilities of contamination with free-living forms from without seem, in the special case, infinitesimal unless the contaminating forms actually passed through the alimentary canal. These doubts having arisen in my mind during further work, make it incumbent upon me to record them lest my previous conclusions should mislead other workers in tropical helminthology.

In view of the addition of the leeches to the Helminthological Department, the entire literature of the subject has been consulted, a checklist of 110 genera has been compiled, and the type-species of each determined. It is believed that the list includes all known forms.

The literature of the large nematode genus *Oxyuris* has also been collected for future work upon the group.

Helminthological Museum.

Considerable additions have been made to the collection of helminth parasites of man and the lower animals. Our thanks are due for valuable specimens received during the last six months from:—

Dr. Ashworth, Edinburgh University (African collections).

Dr. Bayon, Uganda.

Dr. C. W. Daniels (British forms).

Dr. Foy, Northern Nigeria.

Dr. Garrison, Philippines.

Dr. Graham, Gold Coast.
 Prof. King, St. Mungo's College, Glasgow.
 Prof. Mettam, Royal Veterinary College, Dublin (South American Filariae)
 Dr. Maxwell, Formosa.
 Prof. Nuttall, Cambridge.
 Dr. Piper, Palestine.
 Dr. P. H. Ross, British East Africa.
 Dr. Pearson, Congo.
 A. E. Shipley, Esq., Cambridge.
 Dr. Stanton, Malay States.
 Dr. Sells, Uganda.
 Dr. Turner, Transvaal.

Through the continued contributions of students of the School who are now in the Tropics and of others, the Helminthological Museum is gradually acquiring a reference collection of high educational value.

ROBERT THOMSON LEIPER.

Enclosure 3 in No. 1.

London School of Tropical Medicine, Royal Albert Dock, E.,
 20th April, 1909.

Report of the Protozoologist for the half-year ending 30th April, 1909.

During the past half-year my time has been occupied at the London School of Tropical Medicine in the teaching of protozoology, and in the pursuit of certain investigations which will be mentioned below.

Experiments with Soamin and Trypanosoma gambiense.

I have made experiments to test the action of soamin on rats infected with *Trypanosoma gambiense*. For this strain of trypanosomes I am indebted to Professor Mesnil, of the Pasteur Institute, Paris.

While acting as Travelling Pathologist to the Wellcome Research Laboratories, Gordon College, Khartoum, during the years 1907-8, I obtained some promising results with soamin in the treatment of rats infected with *Trypanosoma pecaui*, a trypanosome which is the frequent cause of serious losses amongst transport animals and cattle in the southern part of the Sudan. These experiments were conducted with wild rats taken in traps in the neighbourhood of native villages. The results have been published in the third volume of Reports of the Wellcome Research Laboratories, but it may be mentioned here that it was found possible to bring about a cure in these animals either by administering soamin hypodermically or by the mouth. These results led me, on my return home, to continue experiments with *Trypanosoma gambiense*. As so frequently happens, this drug, which has proved effectual in bringing about a cure in rats infected with certain of the pathogenic trypanosomes of domestic animals, has proved to have a decidedly inferior action on the human trypanosome under similar conditions. In the Sudan wild rats infected with *Trypanosoma pecaui* were employed, while at home white rats and *Trypanosoma gambiense*. In the latter case the action of soamin has not proved to be any better than atoxyl. Rats treated hypodermically or by the mouth have in every case suffered a relapse, and ultimately died of their infection.

With the wild rats used in the Sudan, when perfectly fresh solutions of soamin were used, administration of the drug by the mouth produced no ill effects, while with the white rats employed at home the drug given in the same manner produced paraplegia and various other toxic symptoms. The sample of the drug used in each case was the same (soamin in tabloid form from Burroughs, Wellcome, and Company), so that the difference in the production of toxic symptoms in the two cases may have been due to the fact that the drug was much older (1-1½ years) when used in the latter experiments. If this be the case, it might be claimed that the inferior action on *Trypanosoma gambiense* when compared with the action on *Trypanosoma pecaui* was also due to the change in the specimen of drug used.

Judging from analogy I should not consider this probable, so that it would appear that soamin has an action on *Trypanosoma gambiense* in rats which is not superior to that of atoxyl. This bears out the contention that soamin is in reality atoxyl in another form.

Investigations on Intestinal Protozoa.

When opportunity has occurred by the admission to the wards of the hospital of patients suffering from Protozoa infections of the intestine, I have continued my investigations on these organisms. Large infections of the intestine may occur without any intestinal symptoms whatever. This is especially illustrated by one case that was kept under observation for two months. Large numbers of *Entamæba coli* in all its stages of development, *Lambliia intestinalis* and *Trichomonas*, were constantly to be found, and apart from microscopical examination gave no indication of their presence.

It has recently been claimed that, by the examination of the nuclear structure of the intestinal amœbæ as brought out in fixed and stained specimens, it is possible to differentiate between these various forms, and thus to distinguish *Entamæba coli*, *Entamæba histolytica*, and *Entamæba tetragena*. From a result of my investigations on *Entamæba coli*, I am convinced that this test is quite unreliable, for one and the same amœba in its various stages of development may show nuclear structures which have been supposed to be characteristic of the several amœbæ mentioned above. By an examination of the free-living amœbæ, if not indeed impossible, it is exceedingly difficult and risky, to differentiate the various species. This can, however, be accomplished by the discovery of the developmental forms, which are easily to be distinguished from one another.

In the case of *Trichomonas intestinalis*, one of the common flagellates of the human intestine, I have been led to doubt very seriously whether the structures described by Prowazek as cysts of this flagellate are really what they are claimed to be. It seems probable that the structures have no connection whatever with *Trichomonas intestinalis*. These investigations on the intestinal Protozoa are still in progress, and will be continued whenever material is available.

Investigations on Trypanosomes and other Blood Parasites.

Another line of research has occupied my attention for some time. I refer to cytological studies on the various blood parasites with a view to finding out the true structure of the nuclei and other objects met with in these Protozoa. To this end various fixing and staining reagents have been employed, more especially such as have been found useful in the study of the free-living forms. The elucidation of the true structure of the blood parasites is most important, since it has been recognised that the methods usually employed for their examination are fatal to the minuter details, and thus obscure much of the true structure.

In some blood films made from a tropical American snake (*Erythrolampus æsculapii*) a trypanosome and a hæmogregarine were discovered. Though hæmogregarines from snakes have been frequently recorded, very little is known of trypanosomes from these reptiles. The snake in question harboured many trypanosomes, and it was found that some of these had the true trypanosome structure, others approached the herpatomonoid type in having the micronucleus on the flagellar side of the macronucleus. This trypanosome has been described in a paper entitled "A trypanosome and hæmogregarine of a Tropical American Snake," a copy of which accompanies this report. This is the first instance that a trypanosome of a snake has been described from stained films.

In addition to the researches outlined above, considerable time has been spent in the examination of material received from different sources.

It may be of interest to record that films made from scrapings of tropical ulcers, and sent to the School by Dr. Howard, of Central Africa, were found to contain large numbers of *Spirochaeta schaudinni* originally described by Prowazek, but more recently by Keysellitz and Meyer in greater detail.

My time has also been occupied in teaching Protozoology in the ordinary course on the lines laid down in the Syllabus. It has been found that some students are desirous of pursuing the study of Protozoology further than time will permit in the ordinary course. Accordingly arrangements have been made for the institution of an advanced course in this subject, and this will take practical effect in the forthcoming session. In the advanced course, the teaching will be mainly practical, so that it will be of service to students desirous of pursuing investigations on their return to the tropics.

A copy of the syllabus* of the course in Protozoology is included.

C. M. WENYON.

* Not printed here.

No. 2.

LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 4 November, 1909.)

SIR, Dreadnought Hospital, Greenwich, S.E., 3 November, 1909.
 I HAVE the honour to enclose herewith the half-yearly reports of the Special Departments of the London School of Tropical Medicine.

The work of the School during the year has been attended with unprecedented success, 144 students having entered their names upon the books, as against 96 in the previous 12 months.

These students have come from the following services:—

Colonial Service	...	...	...	...	40
Indian Medical Service	...	...	...	...	18
Royal Army Medical Corps	...	...	...	...	1
Royal Navy	...	...	...	...	1
Other Governments	...	...	...	...	9
Missionaries	...	...	...	...	24
Private Students	...	...	...	...	51
					144

It will be observed from the following table that the great majority of the students enter for the full course of three months:—

For full course of three months	...	...	...	101
„ two months and over	...	...	...	21
„ one month and over	...	...	...	22
				144

Fifty-eight students have joined the School for the present session. This is only rendered possible by considerable enlargement of the laboratories, which was effected during the long vacation. The School authorities have been enabled to carry out this improvement through the generosity of Mr. E. Blessig, a liberal benefactor of the School.

Thirteen students were successful in obtaining the Cambridge Diploma of Tropical Medicine and Hygiene.

I am, &c.,
 P. MICHELLI,
 Secretary.

Enclosure 1 in No. 2.

REPORT OF THE ARTHROPODOLOGIST FOR THE HALF-YEAR ENDING 15TH OCTOBER, 1909.

As explained in a former Report, the work of this Department also includes other branches of medical zoology that are not specially provided for.

The work has made good progress in all directions, and, owing to the liberality of Mr. Blessig, who provided the money for enlarging the laboratory, the facilities for teaching have been enormously increased.

The Collections.—Both the reference collection and the teaching collection have grown, and besides a considerable number of authentically named species and a variety of mounted preparations, we have now a large amount of reserve material for study purposes. It is now possible for the individual student to make himself familiar, by dissection, with all the types of arthropods that are known to be of importance in human and veterinary pathology. Of course, reserves are made to be used; but it is confidently expected that the new establishment for the study of medical zoology in Tropical Africa will aid in replenishing them, and we are already receiving considerable supplies from past students, as is shown in the summary of acquisitions.

With a few exceptions the ticks of the genus *Hæmaphysallis*, which were entrusted to Professor Nuttall, F.R.S., for examination, have been returned. Professor Nuttall very kindly named the species.

Acquisitions.—(1) From *East Africa*: Dr. H. Bayon has continued to send parcels of blood-sucking flies, ticks, *Porocephalus*, and snakes—among the latter some magnificent specimens of the malignant viper, *Bitis gabonica*; Dr. T. C. Johnson has enriched us with the largest, finest, and best preserved collection of ticks yet received from any single source; and Dr. L. Sells has contributed some choice specimens of blood-sucking flies and ticks. From *South Africa*: Dr. G. A. Turner brought us a puff-adder (*Bitis arictans*), and some parasitic maggots and ticks. From *West Africa* the following donations have been received:—From Dr. H. E. Arbuckle some vipers (*Causus rhombeatus*); from Dr. A. W. H. Grant also some vipers (*Echis carinatus*); from Dr. C. Lorena, several poisonous snakes (*Bitis nasicornis*, *Naja nigricollis*, *Dendraspis viridis*), and some insects and scorpions; from Dr. J. Pearson, *Naja nigricollis*, *Dendraspis viridis*, *Causus rhombeatus*, and many blood-sucking flies; and from Dr. C. E. F. Watson, a large number of anophelins mosquitoes, gad-flies, and ticks.

(2) From *Tropical America* we have had flies, ticks, and bugs from Dr. E. Henao; snakes and parasitic maggots from Dr. W. J. von Winckler; and mosquitoes and other flies from the late Dr. C. W. Branch.

(3) From *Asia* Dr. J. M. Atkinson has sent some more specimens of the flies (a Dolichopodid and the Anthomyid, *Lispa sinensis*) said to capture and devour mosquito larvæ in Hong Kong; Dr. W. S. Fletcher has contributed a large and important collection of Malayan mosquitoes and gad-flies; Major Clyde Ford, of the United States Army, has presented a useful lot of plague fleas (*Pulex cheopis*); and Dr. W. Woolliscroft has continued his small donations of parasitic and noxious insects of Negapatam.

(4) *Australia*.—To the Trustees of the Australian Museum at Sydney we are very greatly indebted for a fine series of the venomous snakes of Australia.

(5) *Great Britain*.—We have to thank Dr. Daniels and Dr. Newham for large contributions to our reserves of biting flies; and to Dr. D. Burrows when he was home on leave from West Africa we are indebted for a fine specimen of the European viper.

Teaching.—During the summer session I gave the usual lectures on Arthropoda and Thanatophidæ, and special advanced courses, of a practical character, were instituted in medical entomology, &c., and general medical zoology, *exclusive of* protozoa and parasitic worms. Five students attended the former and two the latter of these courses.

The addition to the laboratory, which we owe to Mr. Blessig's liberality, enables me to make the practical teaching much more comprehensive and exact.

Miscellaneous Matters.—A beginning was made in the summer session to get some exact knowledge of the local flies in regard to breeding habits, periodic increase, &c. Under the impetus of Dr. Daniels the assistants in the general laboratory made some good hauls of blood-sucking flies (*Stomoxys* and *Hæmatobia*) in the neighbourhood of the School.

I may mention, in conclusion, that with the approval of the School authorities, I have accepted an invitation from the Colonial Office to join the new Committee for Entomological Research; also that I have been officially recognised by the University of London as a University Teacher of Medical Zoology.

A. ALCOCK,

Lieutenant-Colonel, I.M.S. (retired).

London School of Tropical Medicine,
Royal Albert Docks, E.

Enclosure 2 in No. 2.

London School of Tropical Medicine,

SIR,

Royal Albert Dock, E., 31 October, 1909.

I HAVE the honour to submit my half-yearly report due October 31st, on the work of the Helminthological Department at the London School of Tropical Medicine, and to forward reprints* of the papers published therefrom during the same period:—

Papers published:—

- (1) The structure and relationships of *Gnathostoma siamense*, "Parasitology," Vol. II., May, 1909.

* Not reprinted here.

- (2) Description of *Filaria mavis* n. sp. from the thrush, "The Zoologist," September, 1909.

Papers at Press for publication in November:—

- (3) The alleged Heterogenesis in *Ancylostoma duodenale*. (November 6.)
 (4) Nematoda, of the Swedish Expedition to German East Africa.
 (5) Check list of the genera of leeches, with their type species. (November 15.)
 (6) A new nematode, causing abscesses in natives of Trinidad. (November 9.)

Papers almost completed:—

- (7) *Cotylonema sorex* n.g.n. sp. (Jointly with Professor King, Glasgow.)
 (8) Observations upon the systematic position of certain human Helminths.

Papers in Preparation:—

- (9) Two new nematodes from sheep. (Jointly with Major McDonald, I.M.S.)
 (10) Life History of the *Trichostrongylus pergracilis*, in relation to Grouse Disease.
 (11) Contributions to the Helminth Fauna of Tropical Africa, Part. I.
 (12) Revision of Cobbold's Collection of Helminthes.

Experimental Work on Grouse Disease.—At the request of the Grouse Disease Committee of Inquiry of the Board of Agriculture and Fisheries, the School Committee granted me leave of absence from my duties at the Tropical School during the month of May to enable me to conduct investigations into this disease in the north of Scotland. Since then much of my spare time has been devoted to this enquiry and the work is not yet concluded. Pending the publication of the final report the following brief summary of the nature and progress of my own work is given for the information of the Committee.

The Committee of Enquiry during the first three years' work had collected a vast amount of information in support of Cobbold's view that grouse disease resulted from the presence of a minute round-worm, *Trichostrongylus pergracilis*, Cobbold, in the cæca of the diseased birds. The object of my investigations was to trace the development of this parasite outside the body, to ascertain the conditions favourable and otherwise to its growth, and to determine the exact manner of its return to the grouse.

My experiments show that the eggs of the parasite can remain alive but quiescent in the stools for several weeks, that the addition of only a small amount of water is necessary to determine the further development of these eggs into embryos. If there be an abundant supply of food and oxygen, the embryos metamorphose after eight days. The larvæ thereon become exceedingly active, and if applied to the roots of a sprig of heather will, during a shower of rain, quickly ascend to the tips of the youngest shoots. As the water disappears in succeeding fine weather the larvæ coil themselves up and, by detaching themselves from their cuticular skin, become encysted. These encysted worms are able to live on heather without the addition of water for some time. Dr. E. A. Wilson has kindly fed some to a healthy grouse, and the bird showed the infection on the fourth day (by the presence of eggs of the parasites in the fæces). When the feeding was continued, the bird gradually lost weight and eventually died.

While these investigations were in progress I observed that several of the birds that had died of disease were heavily infected with Coccidiosis of the small intestine and, later on, while examining young birds, I found that the contents of the cæca consisted of nothing but coccidia, there being an entire absence of *Trichostrongylus pergracilis*. On these grounds I reported the discovery of Coccidiosis as a disease in grouse to the Committee of Enquiry, and this line of investigation was then taken over by the official protozoologist.

With regard to the chronic disease produced in grouse by the *Tr. pergracilis*, there still remains much to be done in the way of experiment before suggestions of any value can be made upon prophylaxis or treatment. On the one hand the infected areas are so enormous, and on the other the habitat of the worm in the body of its host is so secluded. From experiments it would appear that the most susceptible period in the life of the parasite is that between its exit from the egg and its metamorphosis. It is then easily killed by a 2·5 per cent. solution of common salt.

The investigation of the life histories of many other parasites of great economic interest might easily be undertaken by my department if the exceedingly confined quarters at present allotted to it could be augmented.

Teaching.—(a) During the summer session I gave the usual course of lectures and laboratory instruction in Helminthology that forms part of the ordinary curriculum of the School.

(b) An advanced course of practical instruction was given to students who had attended the ordinary course.

(c) One of the members of the advanced class, who was able to devote the necessary amount of time to the subject, engaged in some original investigations that I hope will be published shortly.

(d) One of the "Lectures to Nurses on Tropical Subjects" was given by me.

Helminthological Museum.—More suitable accommodation for the collection will soon become a matter of urgency. Considerable additions have again been made to the Helminthological Museum, and valuable collections have been received from Drs. Sells, Bayon, and Johnston in Tropical Africa, and Dr. Stanton, Malay States. Specimens have been acknowledged from correspondents in various parts of the world. At the request of the Editor, a short article on "Tapeworms in Roach" was contributed to the "Anglers' News," the specimens having been forwarded in connection with a correspondence in that journal.

I have, &c.,
ROBERT T. LEIPER.

Enclosure 3 in No. 2.

REPORT OF PROTOZOOLOGIST FOR SIX MONTHS ENDING OCTOBER 31ST, 1909.

During the past six months my time has been occupied at the London School of Tropical Medicine partly in teaching and partly in pursuing original investigations.

Owing to the institution of advanced courses in Protozoology and the increase in the number of students attending the School, some of whom receive special instruction outside the regular courses, an increasing amount of time is taken up in teaching duties.

The advanced courses which have been under consideration for some time took practical form last session. The number of students attending the Protozoological Section of the advanced courses was five, a most gratifying attendance for the first class. In this course students receive instruction in those methods of preparation and investigation which cannot be undertaken in the ordinary course, and it is hoped that this will prove a further stimulus to original investigation on the part of students when they return to the Tropics. Unfortunately the accommodation available for conducting the advanced course in protozoology is somewhat limited and unsuitable, nor does it allow of much scope for improvement. If students are to be encouraged to undertake investigations of their own when they return to the Tropics they must receive their instruction under the most favourable conditions, and the first essential is a convenient and well-equipped laboratory, large enough to accommodate the whole class and to give each student sufficient space to carry on the work of the advanced course. In an advanced class each student requires more space than in an elementary class, but unfortunately the conditions under which the advanced classes in protozoology are at present conducted are far from being ideal and leave much room for improvement.

During the past six months three students have attended for periods of about one month each and have received special instruction in protozoology.

The examination of material received from former students stationed in the Tropics has occupied a considerable portion of my time. In all cases where possible the specimens have been identified, and the result of the examination communicated to the sender.

Whenever opportunity has arisen I have continued my investigations on the intestinal protozoa of man. Several cases in the wards of the hospitals have enabled me to make some progress in this direction. Two cases were injected with lamblia intestinalis and I was thus able to make some observations on this intestinal flagellate, which most probably is the cause of serious intestinal derangement. The flagellate in question is very persistent and difficult to get rid of. In the intestine it becomes encysted in oval cysts of about 12μ in length. These cysts pass out from the body, and are the cause of the transmission of the infection to healthy individuals. The exact process of the development of the lamblia within the cyst I have not yet been able to follow, but I have seen nothing to support the contention

that lamblia is merely the sexual form of another intestinal flagellate, viz., octomitus. The presence of lamblia in the intestine may be determined by the discovery of the encysted forms in the stool.

Intestinal amœbæ have been encountered from time to time, but I have nothing new to add to the present knowledge of these protozoa except to emphasise the fact that a great variation exists amongst these amœbæ and that it does not appear to me safe to accept morphological differences alone as an indication of a difference of species. It is highly probable that the amœbæ in the intestine are subjected to considerable variations in the medium in which they live, and that they respond to these variations by a corresponding change in their own structure and appearance.

I have also been engaged in investigating the so-called encysted forms of trichominas, but I have no further remark to make upon this subject at present. The life history of another interesting flagellate has occupied my attention, but the details of this, together with some observations I have made on a flagellate obtained from the intestine of a man from the West Indies, will be reported upon at a future date.

C. M. WENYON.

APPENDIX VI.

No. 1.

THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL
OFFICE.

(Received 1 May, 1909.)

SIR, B 10, Exchange Buildings, Liverpool, 30th April, 1909.
I HAVE the honour to enclose, for the information of the Tropical Diseases Advisory Committee, the following reports of the Liverpool School of Tropical Medicine for the six months ending 30th April, 1909, viz. :—

- (1) Report of the Walter Myers Lecturer of the School (Dr. J. W. W. Stephens).
- (2) Report of the Director of the Runcorn Research Laboratories of the School (Dr. A. Breinl).
- (3) Report of the Lecturer in Economic Entomology and Parasitology (Mr. R. Newstead).

I am, &c.,
A. H. MILNE,
Secretary.

Enclosure 1 in No. 1.

SIR, The Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool, April 30th, 1909.
I BEG to submit the following report on the work done during the period from November 1st, 1908, to April 30th, 1909 :—

Students.

The number of medical men who attended the Autumn term was 11, and the number for the Lent term 15; total 26. Of these, six belonged to the Indian Medical Service, one to the Royal Army Medical Corps, seven to the West African Medical Staff, three to the Colonial Medical Service, nine miscellaneous.

Diploma of Tropical Medicine.

The number of candidates who entered for the examination in December was nine, of whom eight passed. The number of candidates for the April examination was 14, of whom 12 passed.

Museum.

The thanks of the School are due to the following gentlemen for their kindness in sending specimens to the School during the last six months :—Dr. Spillane, North-

Eastern Rhodesia; Dr. R. H. Kennan, Sierra Leone; The Royal Infirmary, Liverpool; Dr. C. F. Watson, Lokoja; Dr. W. J. Bruce; Major Davidson, I.M.S., Dr. Renner, Sierra Leone; Dr. Orpen, Sierra Leone; Dr. F. Storey, Gold Coast; Dr. A. H. Hanley, C.M.G., Professor Looss, Cairo; Dr. Breinl, Runcorn; Dr. J. B. Bate, Southern Nigeria; Dr. A. Kinghorn and Mr. R. E. Montgomery, Expedition to the Zambesi; Dr. Prout, Jamaica Expedition; Mr. R. Newstead, Jamaica Expedition; Dr. C. Christy; Drs. Barrett and Yorke, Blackwater Fever Expedition; Dr. Dalal, Bombay; Dr. Grabham, Kingston, Jamaica; Dr. J. A. Allwood, Kingston, Jamaica.

Extended Course of Instruction.

The extended course, lasting three full months (13 to 14 weeks), has, I consider, proved a great benefit. Although it does not admit of the study of much new matter, yet it has proved of great advantage in that it permits of more careful and less hurried study than was formerly the case. New matter has, however, been added to the extent of nine practical classes in Bacteriology by Dr. Stenhouse Williams, Lecturer in Public Health. This is a distinct gain, although it is still obvious that the time devoted to this and other subjects is inadequate.

Research Work.

In the "Annals of Tropical Medicine," Volume II., No. 4, I published a description of a new Human Nematode, *Strongylus Gibsoni*, and I have at present in preparation a paper on some specimens of *Cysticercus cellulosæ* from man.

I have, &c.,

J. W. W. STEPHENS,

Walter Myers Lecturer in Tropical Medicine.

The Secretary,
Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

Enclosure 2 in No. 1.

Department of the Director of the Tropical Research Laboratories, Runcorn.

30th April, 1909.

SIR,

As requested, I have the honour to report, in brief, on the work which has been carried out at the Runcorn Research Laboratories of the Liverpool School of Tropical Medicine, during the six months ending 30th April, 1909.

The money was largely utilised in assisting the current expenses of the laboratory, particularly in the purchase and maintenance of experimental animals, which have been used mainly for the continuation of our experimental work on sleeping sickness treatment, especially on treatment with different drugs.

The staff of the laboratory consisted during the said period of Dr. Anton Breinl, Director, and Dr. Max Nierenstein. Mr. E. Hindle resigned his position as Research Assistant at the end of December, 1908.

Drs. J. O. W. Barratt and J. W. Yorke have been working here since March, finishing up their report on the results of the Blackwater Fever Expedition.

Unfortunately, through the lack of funds at the disposal of our laboratory, the work has been very largely curtailed of late. We have not been able to work on the treatment of experimental trypanosomiasis on such a scale as to make it conclusive for the practical application of the different modes of treatment to natural infections. We were only able to use large animals and monkeys in a very limited number. Furthermore, a good deal of our time was taken up by routine work through the lack of assistance. Part of our research work, therefore, has been greatly curtailed and part had to be abandoned before yielding any definite results.

During the said period the following work has been done:—

I. Breinl continued the study of the life-history of *T. Lewisi* in the rat louse,

the intermediary host. However, the results are not yet sufficiently complete to warrant the expression of a definite opinion.

II. Nierenstein and Breinl have completed their work on the mechanism of the action of atoxyl in the organism. They were able to show that atoxyl, after injection, is subjected in the organism to the oxidising action of oxidative ferments. After a combination of atoxyl with the proteins of the serum, &c., arsenic is set free and acts on the trypanosomes. At the same time, a reduction process on a smaller scale goes on in the intestines, and also through this process arsenic is set free from the atoxyl. Nierenstein was able to strengthen this theory through his work on the secretion of atoxyl, and was able to show that the drug is secreted in the urine in an oxidised form.

III. Nierenstein and Breinl continued their work on organic antimony compounds, and gave three isomeric aryl-stibinic acids a fairly thorough trial. Only the para compound, which is an antimony compound analogous to atoxyl, gave promising results, and, in our opinion, will be a valuable asset for the practical treatment of sleeping sickness, although it does not seem to be very promising for the treatment of cattle trypanosomiasis.

IV. Breinl and Nierenstein furthermore used arsenic-phenylglycine for experiments on a few large animals infected with *T. Brucei* and *T. Evansi*. The time of observation, however, is too short to give any conclusive opinion, but preliminary experiments made it probable that arsenic-phenylglycine is decidedly superior to atoxyl for the treatment of large animals. Whether complete cures can be obtained can only be decided after a prolonged period of observation. At the same time, observations have been made on the mechanism of the action of this compound which tend to show that also in this drug it is mainly the arsenic which accounts for the trypanocidal action of the compound.

V. Breinl concluded his experiments on the combined treatment of atoxyl and mercury on monkeys infected with *T. gambiense*. The time of observation (nearly one year since treatment was discontinued) allows one to conclude that the animals are definitely cured of the disease.

VI. Breinl, in collaboration with Professor H. E. Annett, have attempted to elucidate the mechanism of the hæmolysis in *Piroplasma canis*. They have come to the conclusion that the hæmoglobinuria is not due to a formation of a specific hæmolysin or isolysin, but is only due to the mechanical disintegration of the red blood corpuscles after the escape of the parasites from them.

The following papers have been published since 30th October, 1908 :—

Comparative chemotherapeutical study of Atoxyl and Trypanocides. Part II., by M. Nierenstein. *Annals of Tropical Medicine and Parasitology*, Vol. II., No. 4, 1909.

Chemical Notes on Atoxyl, by M. Nierenstein. *Annals of Tropical Medicine and Parasitology*, Vol. II., No. 4, 1909.

A new *Porocephalus* (*Porocephalus cercopithecii*, n. sp.), by Anton Breinl and Edward Hindle. *Annals of Tropical Medicine and Parasitology*, Vol. II., No. 4, 1909.

Zum Mechanismus der Atoxylwirkung, von A. Breinl und M. Nierenstein *Zeitschr. für Immunitätsforschung und experimentelle Therapie*, Erster Band. Fünftes Heft. 1909.

I am, &c.,

ANTON BREINL,

Director of the Runcorn Research Laboratories.

The Secretary,

Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

Enclosure 3 in No. 1.

Department of Medical and General Economic Entomology.

30th April, 1909.

SIR,

I BEG to submit the following report for the half-year ending April 30th, 1909.

Students.

The usual courses of instruction in medical entomology were given.

Expedition to Jamaica.

The members of this expedition consisting, in the first instance, of Dr. W. T. Prout and myself, arrived in Jamaica on the 27th November, 1908, and after a stay on the island of 62 days we sailed from Kingston on the 28th January, 1909.

On our arrival at Kingston we were met by the Colonial Secretary to His Excellency the Governor, the Secretary of the Agricultural Society, and others. His Excellency received the members of the expedition the same day, and did everything that was possible to further the object of the expedition. A large bungalow at Constant Spring Hotel was set apart for our use as a laboratory by Sir Alfred Jones, but all the spraying experiments with cattle were carried out at the Government laboratories in the Hope Gardens. The Honourable H. E. Cousins, Director of Agriculture, assisted me in all the spraying experiments; and Mr. E. J. Wortley, Lecturer in Agricultural Science, was appointed to take a course of training under me during the two months, so that he should be in a position to continue the investigations after my departure. With the combined help of the Director of Agriculture and his assistant, I was able to accomplish a great deal more than could otherwise have been done in the limited time at my disposal; and I tender to these gentlemen my warmest thanks for the many ways in which they assisted me in my work, and also for the full reports on the results of the spraying experiments with which they have furnished me since my return to England.

Cattle Ticks.

1. About 100 circulars were sent out to a corresponding number of planters and pen keepers in various parts of the island. The replies to these, for the most part, contained valuable data and information bearing upon the various methods of control, such as the dips which are in general use on the island, the effect of firing grazing land, the rotation of crops, &c. Tubes were sent with each circular, with the request that examples of ticks from cattle and other domesticated animals be sent for examination. The specimens thus collected proved of much value and interest, affording one also an excellent idea as to their relative abundance and geographical distribution.

2. Twenty-five estates were visited, and the cattle inspected in each of them. This entailed a considerable amount of travelling, occupying in all about 35 days. The pens were situated in nine of the 14 parishes into which the island is divided, four estates being in the extreme western portion, a day's journey from Kingston. Large numbers of ticks were collected in each district; special attention was given to cattle and "horse kind," though examples of the wild vertebrate fauna were examined whenever specimens were procurable.

3. The methods of treating tick-infested stock were made the subject of enquiry, and whenever possible a practical demonstration of the methods of applying washes and dressings was witnessed by myself.

4. No cases of Texas fever or any other form of Piroplasmosis was discoverable in any of the cattle which were inspected, so that it was not possible to ascertain whether the so-called "Texas fever" is caused by the *Piroplasma bovis* or an allied species.

5. The last three weeks of my stay in the island were devoted chiefly to the spraying of cattle with various kinds of washes.

The Director of Agriculture has favoured me with a preliminary report on the results of these experiments, and in his communication, dated the 6th March, 1909, he says:—"Our results have been most encouraging. The sprayed cattle have remained almost free from ticks although left five weeks in the Mona pasture, which as you know is just alive with ticks." Further, that the most effective spraying wash was a mixture of "paranaph" and sulphide of arsenic with free sulphur, which proved the most persistent and adherent tick-destroying medium of any. Judging from these highly satisfactory results, he is sanguine that the "tick problem in Jamaica can be controlled cheaply and effectively with appliances readily obtainable and usable by any owner of stock."

6. The life cycles of all the species of Ixodoidea peculiar to the island were started, but in no case completed.

7. An article on the ticks of Jamaica is in the course of preparation for publication in the Government Bulletin issued by the Department of Agriculture; and a more extensive paper will be issued in the "Annals of Tropical Medicine and Parasitology."

Insects and other pests injurious to Cultivated Crops.

8. The nature and extent of the injury caused by insects and other pests to cocoa, cotton, rubber, banana, orange, and other cultivated plants were investigated in many parts of the island; and advice on the practical methods of controlling the pests were given whenever it was possible to do so. A large amount of material was also collected in various parts of the island.

The Food of Birds in relation to Agriculture.

9. His Excellency the Governor, Sir Sydney Olivier, K.C.M.G., granted a special licence to procure birds in order to ascertain to what extent they preyed upon cattle ticks and other agricultural pests. Special attention was given to the insectivorous species, and out of about 50 post-mortem examinations eight birds were found to contain cattle ticks.

A paper on the injurious scale insects and other agricultural pests of Jamaica will be published so soon as the material can be collected. This matter will form Part II. of my report on the expedition and will, in all probability, be issued in the Government Bulletin.

In addition to the training of the Government Lecturer, five special demonstrations were given to various other Government officials, and all the members of the Royal Army Medical Corps.

Two public lectures were given at Kingston—one on cattle ticks, the other on the scale insects affecting the cultivated plants in Jamaica. His Excellency the Governor was present, and the attendance good. These lectures were given in connection with the Jamaica Institute.

Before leaving the island a letter of thanks was addressed to the Governor, Sir Sydney Olivier; and at the same time also a draft scheme for the continuance of the investigation relating chiefly to the control of cattle ticks was addressed to the Director of Agriculture.

Papers Published.

1. "The Food of Some British Birds," pp. I.-V., 1-87. Issued as a supplement to the journal of the Board of Agriculture, Vol. XV., No. 9. December, 1909.

This report forms a preliminary contribution to the scientific enquiry recently initiated by the Board of Agriculture and Fisheries. This memoir is based upon some 1,100 post-mortem and other exact records which, from an entomological standpoint are, it is believed, the most extensive that have yet been compiled in this country, and as such form a valuable contribution to our knowledge of the food of British birds, especially in relation to agriculture and horticulture. A copy of the memoir* is enclosed herewith.

2. A further contribution on the Coccidæ and Aleurodidæ of Madagascar and Comoro Islands. "Reise in Ostafrika in den Jahren 1903-1905 mit Mitteln der Hermann und Elise geb. Heckmann Wentzel-Stiftung ausgeführt von Professor Dr. Alfred Voeltzkow. Wissenschaftliche Ergebnisse. Zweiter Band. Systematische Arbeiten. (1909.)"

Copy of memoir* enclosed.

I have, &c.,

ROBERT NEWSTEAD,

Lecturer in Economic Entomology and Parasitology.

The Secretary,

Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

* Not reprinted.

No. 2.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 1 November, 1909.)

SIR, B 10, Exchange Buildings, Liverpool, 30th October, 1909.

As requested, I have the honour to enclose, for the information of the Tropical Diseases Advisory Committee, the following reports of the Liverpool School of Tropical Medicine for the six months ending 31st October, 1909, showing the manner in which the Government grant to the School has been expended, viz. :—

- (1) Report of the Walter Myers Lecturer of the School (Dr. J. W. W. Stephens).
- (2) Report of the Director of the Runcorn Research Laboratories of the School (Dr. Anton Breinl).
- (3) Report of the Lecturer in Economic Entomology and Parasitology (Mr. R. Newstead).

I am, &c.,
A. H. MILNE,
Secretary.

Enclosure 1 in No. 2.

SIR, B 10, Exchange Buildings, Liverpool, 31st October, 1909.

I BEG to submit the following report on the work done during the period from 1st May to 31st October, 1909.

Students.—The number of medical men who attended the short course of instruction during the month of June was 10, and the number for the full three months' autumn course 22—total, 32. This number includes members of the Royal Army Medical Corps, Indian Medical Service, West African Medical Staff, Colonial Medical Service, &c.

Diploma of Tropical Medicine.—The examination for the Diploma of Tropical Medicine is now held twice in the year, viz., on April 14th and December 14th.

Research Work.—My observations on the *Cysticercus cellulosae* were published in the Annals of Tropical Medicine and Parasitology, Vol. II, No. 5, under the title "Observations on the Hooklets of *Cysticercus cellulosae* in Man."

Museum.—The thanks of the School are due to the following gentlemen for their kindness in sending specimens to the School during the last six months :—Dr. R. H. Kennan, Sierra Leone; Dr. F. H. Storey, Gold Coast; Dr. Jackson Moore, Sierra Leone; Royal Southern Hospital, Liverpool; Dr. Bell, Hong Kong; Major Davidson, I.M.S., Dr. Mackey, Belize, British Honduras; Dr. J. H. Hugh Harrison, Belize, British Honduras; Drs. Barratt and Yorke, Blackwater Fever Expedition; Dr. Allan Kinghorn and Mr. R. E. Montgomery, Expedition to the Zambesi; Dr. H. Wolferstan Thomas, Expedition to Manaus, Brazil; Dr. K. S. Wise, British Guiana; Dr. Davey, Rhodesia; Major Donovan, I.M.S., Madras; The School of Medicine, Cairo; Dr. Ferguson, Cairo.

Extended Course of Instruction.—The number of medical men, viz., 22, that have entered for the winter course has strained the accommodation of the laboratory and the capacity of the teaching staff. Should this number be maintained, it will be imperative immediately to appoint a demonstrator.

I have, &c.,
J. W. W. STEPHENS,
Walter Myers' Lecturer in Tropical Medicine.

The Secretary,
Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings,
Liverpool.

Enclosure 2 in No. 2.

SIR, B 10, Exchange Buildings, Liverpool, 30 October, 1909.

As requested, I have the honour to report in short on the research work which has been done at the Runcorn Research Laboratories of the Liverpool School of Tropical Medicine from the 1st of May till the 30th of October, 1909.

The money has been used mainly for defraying the current expenses of the laboratory, chiefly for the purchase and maintenance of experimental animals to provide the strains of different trypanosomes for teaching purposes, and to carry on the different pieces of research work which have been started.

Dr. Nierenstein resigned his position on the staff of the laboratory at the beginning of May, and Dr. Yorke was appointed assistant at the beginning of July.

I. Dr. Breinl continued and finished his study of *T. lewisi* in the rat louse, *Hæmatopinus spinulosus*. He came to the conclusion that a definite life-history of *T. lewisi* takes place in the gut of the rat louse. He has been able to prove in stained specimens, controlled by fresh examinations, that the trypanosomes change their form and shape and become herpetomonas-like. He was able to transmit *T. lewisi* in three experiments out of five by means of the rat louse from infected to healthy rats. The paper containing these results will appear shortly in the *Annals of Tropical Medicine and Parasitology*.

II. Breinl and Nierenstein concluded their experimental study on the action of arseno-phenyl-glycine in experimental trypanosomiasis. They were able to show that arsenic-phenyl-glycine, as far as experimental animals are concerned, is certainly superior to atoxyl, and especially have they succeeded in curing dogs infected with *T. brucei*. However, in large animals arsenic-phenyl-glycine failed to effect a cure, as all large animals, such as horses, donkeys, &c., succumbed to the infection of *T. brucei* after a varying period, in spite of the repeated administration of very large doses of this drug. Furthermore, they have been able to prove that after the injection of arsenic-phenyl-glycine a very marked increase of the amount of fat and lecithin in the blood takes place, which seems to indicate that the fat formed from the proteins of the organism forms an additional product with the arsenic set free in the serum for the purpose of rapidly eliminating the poison. The results of this work will appear shortly in the "*Zeitschrift für Immunitätsforschung*" under the title of "*Zur Wirkung des Arsenic-phenyl-glycines*."

III. Breinl and Nierenstein have concluded their study of trypanocidal drugs and their derivatives.

IV. Drs. Barratt and Yorke have completed at this laboratory their report on the Blackwater Fever Expedition. They have been studying the mechanism of the production of blackwater in *Piroplasma canis* in comparison with the mechanism of its production in blackwater fever. They have been able to show that the mechanism of production of blackwater is similar in the two diseases. The hæmoglobinuria is dependent upon and preceded by hæmoglobinæmia. They have made quantitative estimations of the amount of hæmoglobin passed in the urine and also of the amount present in the blood plasma of dogs suffering from *Piroplasma canis*. Further, they have proved that the watery condition of the blood found in the last stage of the disease is due to a diminution in the number of red corpuscles and not to an increase in the fluid constituents of the blood. The results of this work will shortly appear in the "*Zeitschrift für Immunitätsforschung*."

V. Dr. Yorke has taken up the study of immunity in trypanosome diseases. He has been able to prove that a diminution of the hæmolytic complement only takes place in the last stages of the disease, and that the complement has practically vanished shortly before the death of the animal, when the blood was swarming with parasites.

VI. He has also been working on the protective action of the serum of animals either in a state of chronic infection or immune to various kinds of trypanosomes. He has been able to demonstrate that marked phagocytosis and lysis of the trypanosomes takes place when the immune serum and trypanosomes are injected together into the peritoneal cavity of rats.

VII. Dr. Yorke has attempted to confirm Professor Nuttall's experiments on the beneficial effect of trypanblue for the treatment of *Piroplasma canis*. He has

been unable to confirm Nuttall's good results. This may be due to the fact that the piroplasma strain with which he has been working was of extreme virulence. Trypanblue had a decided influence on the parasites, as they diminished in number after an injection, but he has not been able as yet to save a single animal from death.

The following papers have appeared since April 30th:—

Biochemical and Therapeutical Studies of Trypanosomes, by Anton Breinl and M. Nierenstein. *Annals of Tropical Medicine and Parasitology*, Vol. 3, No. 3.

Experiments on the Combined Atoxyl-mercury Treatment in Monkeys infected with *T. gambiense*, by Anton Breinl. *Annals of Tropical Medicine and Parasitology*, Vol. II., No. 5, May, 1909.

The Action of Aryl-Syibinic Acids in Experimental Trypanosomiasis, by Anton Breinl and M. Nierenstein. *Annals of Tropical Medicine and Parasitology*, Vol. II., No. 5, May, 1909.

Short Note on the Mechanism of Haemolysis in *Piroplasma Canis*, by Anton Breinl and H. E. Annett. *Annals of Tropical Medicine and Parasitology*, Vol. II., No. 5, May, 1909.

Ueber die Ausscheidung des Atoxyls in Pferdeharn, von M. Nierenstein. *Zeit. f. Immunitätsforschung und experimentelle Therapie*, Zweiter Band, Viertes Heft, May 25th, 1909.

I am, &c.,

ANTON BREINL,

Director, Runcorn Research Laboratories.

The Secretary,

The Incorporated Liverpool School of Tropical Medicine,
Liverpool.

Enclosure 3 in No. 2.

SIR,

B 10, Exchange Buildings, Liverpool, 31 October, 1909.

I HAVE the honour to submit my report for the half-year ending October 26th, 1909:—

Instruction.—A course of 20 lectures and 20 demonstrations were given during the short midsummer course ending June 30th.

A special course of instruction was also given to the Government entomologists appointed by the African Entomological Research Committee. This course included:—

(a) The various methods of collecting, preserving, and mounting insects and other Arthropoda.

Medical:—

(b) The characteristics of African blood-sucking insects representing the following genera:—Culicoides, Phlebotomus, Simulium, Tabanus, Hæmatopota, Pangonia, Chrysops, Hippocentrum, Rhinomyza, Lyperosia, Stomoxys, Musca, Auchmeromyia, Pycnosoma, Glossina (all known species), &c.

(c) The typical mosquitoes of Western Africa, the Congo Free State, and other portions of the Continent.

(d) Several genera of the African Hippoboscidae.

(e) Various larvæ producing myiasis in man and mammals.

Agricultural:—

(f) Scale insects (Coccidae) affecting various cultivated plants, &c.

(g) Aleurodidæ, Psyllidæ, and Aphidæ.

(h) African cotton pests of various orders.

(i) Insects pests affecting cocoa, rubber, &c.

Literature.—The principal literature dealing with African economic entomology was also discussed especially in relation to the methods of prevention and control.

Material furnished for the Expedition.—Each student was provided with a typical collection representing a number of species of scale insects (Coccidæ), and also a list of all the more important publications dealing with economic entomology.

I have to report also that special instructions have been given to those members of the School staff who are going out on expeditions to the tropics.

I have attended the various meetings of the African Entomological Research Committee, and have assisted in the preparation of the circulars dealing with the collecting and preservation of insects, &c.

Papers published.—Report of the Twenty-first Expedition of the Liverpool School of Tropical Medicine to Jamaica, Part I. *Ticks and other Blood-Sucking Arthropoda*, pp. 49, 10 figures. A copy of this report* is submitted herewith.

The following headings are discussed in this paper :—

1. The seasonal prevalence of ticks.
2. Effect of rain or water on ticks and their eggs.
3. Dissemination of cattle ticks by various agencies.
4. The prevailing conditions under which pastures are either most free or most infested with ticks.
5. Longevity of ticks without access to a host.
6. The life-cycle of ticks.
7. Structural characters of ticks.
8. Synoptic table to the Jamaica ticks.
9. Descriptions of all the known species of Jamaica ticks.
10. The natural enemies of the Jamaica ticks.
11. Rotation of crops as a method of eradicating tick-infested pastures.
12. Results obtained by burning pastures.
13. Apparatus for spraying and dipping cattle.
14. Cattle washes and dips.
15. Conclusions.
16. Glossary.
17. Myiasis in man produced by the larvæ of *Cryomyia macellaria*.
18. The horn-fly (*Lyperosia irritans*), recent appearance of in Jamaica.
19. The stable fly (*Stomoxys calcitrans*). Some notes on the habits of the larvæ.
20. A new blood-sucking Tabanid (*Chrysops jamaicensis*, Newstead).
21. Notes on two species of Hippoboscid flies (*Ornithoctona erythrocephala* and *Trichobius parasiticus*).
22. The Chiggoe flea (*Dermatophilus penetrans*) in man and domesticated animals.

House Fly Investigation.—This investigation has been continued throughout the summer and autumn, and is still being carried on. The plan of campaign was drafted under the supervision of Dr. Monckton Copeman, F.R.S., of the Local Government Board, and Dr. E. W. Hope, the Medical Officer of Health for Liverpool. The subjects under consideration in connection with this investigation are :—

1. The true scientific evidence regarding the role of the house fly as a carrier of disease.
2. Methods of control.
3. Inspection of fly-infested areas.

A complete register of these investigations has been kept since the beginning of July, and it is intended that a full report shall be issued towards the end of the year. Material assistance has been rendered in this work by Dr. Hope, who

* Not reprinted.

appointed one of his sanitary inspectors to collect the material at the various centres, without whose help it would have been impossible to carry out the programme as indicated above. Copies of the charts and schedule* are submitted herewith.

I have, &c.,

ROBERT NEWSTEAD,
Economic Entomologist and Parasitologist.

The Secretary,
Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

APPENDIX VII.

REPORTS ON WORK DONE IN COLONIAL LABORATORIES.

No. 1.

BARBADOS.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 26 July, 1909.)

MY LORD, Government House, Barbados, 9th July, 1909.

WITH reference to your circular despatch of the 13th July, 1908,† enclosing copies of the reports from the Tropical Schools at London and Liverpool and from the Colonial Laboratory at Hong Kong, and asking for any observations which it may be desired to offer on these reports, I have the honour to enclose a copy of a minute by Dr. John Hutson, the Poor Law Inspector, on the subject.

2. I regret the delay that has occurred in replying to this despatch, but the Barbados Branch of the British Medical Association, to whom the reports were in the first instance referred, after several attempts, failed to convene a meeting for the purpose of considering the matter, and, as a last resort, I had to ask Dr. Hutson to consider it and favour me with a report.

I have, &c.,
G. T. CARTER,
Governor.

Enclosure in No. 1.

MINUTE BY POOR LAW INSPECTOR.

HONOURABLE COLONIAL SECRETARY,

I REGRET that this matter has been overlooked. Medical matters of this kind have been referred to me in the first instance for many years, while recently such reports and medical questions have been referred to the Barbados Branch of the British Medical Association.

2. The reports of the London and Liverpool Tropical Schools disclose the routine work of the schools and the investigations of various observers engaged in research work.

3. The report from Hong Kong refers to the work of the Government Bacteriologist, which is full of interest and is a good example of the useful work of men devoting their time to scientific observations and research.

4. There is not much in these reports of direct practical importance to us in Barbados, except the proposed opsonic treatment of leprosy in Hong Kong, the result of which will be awaited with interest and will doubtless be announced in due course.

5. The reports are, however, in the nature of an object lesson of the work of medical research which is being done in the Tropical Schools and in the Colonies. There is ample scope in Barbados for research work on disease. The problem of pellagra awaits solution, and, owing to the prevalence of filariasis, the Colony is

* Not reprinted.

† Not printed.

specially suitable for investigation into the problems of this disease. Ankylostomiasis is common, but its percentage is yet to be worked out, and little attention is paid to it.

6. The need of a bacteriologist has been apparent for many years, and the recent action of the Board of Health on a minute of the Health Officer of the Port is an important move in this direction. It is important to bear in mind, however, that a bacteriologist to do routine laboratory work will not be able to undertake much research work unless the routine examination of specimens and diseased tissues is small in amount. There is one important point to be emphasised in connection with tropical problems in Barbados, which is that no malaria exists in Barbados and that the mosquito carrier of malaria, the *anopheles*, is not known. The latter fact was confirmed by the researches of Dr. G. C. Lowe, of the London Tropical School, during his special visit to the Colony in 1901.

7. The fact that Barbados is free from malaria should be specially proclaimed, in view of the fact that recent public utterances have included Barbados amongst the malarious Colonies of the West Indies.

J. H.

9 July, 1909.

No. 2.

BRITISH GUIANA.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 9 August, 1909.)

MY LORD, Government House, Georgetown, Demerara, 21 July, 1909.

I HAVE the honour to enclose the report of Dr. Wise, the Government Bacteriologist, on the work carried on by Professor Deycke at the Leper Asylum in this Colony. Dr. Wise's report appears to give promise of a considerable measure of success in connection with the treatment. More, no doubt, will appear in the paper which Professor Deycke will read at the Leprosy Conference at Bergen.

I have, &c.,

CHARLES T. COX.

Enclosure in No. 2.

Government Bacteriological Department, Georgetown,

SIR. British Guiana, 9 July, 1909.

I HAVE the honour to forward herewith a preliminary report on the results of Professor Deycke's treatment of leprosy at the Leper Asylum, Mahaica, British Guiana.

2. I do not think that the treatment has yet been carried to such a stage that any definite decision can be given of its value, but in view of the great importance of the subject, and also of the impending congress at Bergen, I have taken the opportunity of reporting on the results of the first six months' work.

I have, &c.,

K. S. WISE,

Government Bacteriologist.

The Honourable

The Surgeon-General.

A PRELIMINARY REPORT on the Results of Professor Deycke's Treatment at the Leper Asylum, Mahaica, British Guiana.

Professor Deycke began his treatment in December, 1908, at the Leper Asylum, Mahaica, and continued till May, 1909, at which time he departed from the Colony. Since May the treatment which he instituted has been carried on in accordance with his principles by the Medical Superintendent.

2. Acting on instructions from the Surgeon-General I have proceeded frequently during the last week in May and the month of June to the Leper Asylum, in order

to ascertain as far as is possible any results which may have accrued from this new treatment.

3. The new treatment which Professor Deycke has instituted comprises the injection of a substance called nastin. The injection consists of one part of nastin in 10 parts of 2 per cent. benzoyl chloride solution; there are two weaker solutions consisting of 1 in 40 and 1 in 100 respectively, which are used in cases of extreme individual reactivity. The injections are performed subcutaneously once a week for a period of 3 months, they are then omitted for 3 months, and recommenced for 2 months with again a period of quiescence for 2 months, and then a repeated injection period for 3 months.

4. It is claimed that under the influence of nastin the bacilli of leprosy are destroyed. In Professor Deycke's own words "benzoyl nastin is an agent which directly acts on lepra bacilli" (Address to the British Guiana Branch of the British Medical Association, January, 1909.) "The final effect of the specific injection in the case of leprosy is, indeed, something thoroughly substantial which may be verified any time by microscopical examination; it is the destruction of the bacilli heralded in by the removal of fat of the lepra bacilli" (translated from *Lepra*, Bibliotheka Internationalis, Vol. VII., fasc 3).

It is obvious, therefore, from the above quotations that in estimating the value of this treatment a careful distinction must be made between the influence on the tissue changes caused by those bacilli.

While it is claimed that the bacilli will be destroyed, the disease, therefore, arrested, and contagion impossible; it is not claimed that the nastin will return the discoloured patches of skin to the normal colour replace the deformed limbs by new ones, or eliminate the massive infiltration of the face and restore a natural countenance.

However, the professor states that even this last may in certain instances be accomplished "but there are leprous formations (not only normal forms of exanthema, but also more solid, even massy, infiltrations, some of them of large extent) which are acted upon and done away with by nastin not less promptly than, say, syphilitic eruptions are by mercury." (*Lepra*, Vol. VII., fasc 3.) It would appear as though once the cause of the thickenings and tumours is removed, the natural processes of the body proceed to diminish the excessive tissue formation.

5. In order to ascertain how far the above claims are justified, 50 cases of leprosy were examined. The following tables show the age, race, country of origin, the approximate length of time the disease had been in progress, the length of time under treatment, and the type of leprosy involved in these 50 cases.

TABLE I.

<i>Age.</i>						
1-10 years	...	...	...	...	...	0
11-20 ,,	...	...	...	...	...	28
21-30 ,,	...	...	...	...	...	11
31-40 ,,	...	...	...	...	...	7
41-50 ,,	...	...	...	...	...	1
51-60 ,,	...	...	...	...	...	2
61 and over ...	...	..	..	...	...	1
						50

TABLE II.

<i>Race.</i>						
Black	...	...	...	...	...	34
Mixed	...	...	...	...	...	5
East Indian	...	...	...	...	...	6
Chinese	...	...	...	...	...	1
Portuguese	...	...	...	...	...	2
Other European races	...	...	...	...	...	2
						50

TABLE III.

<i>Country.</i>						
British Guiana	...	...	...	...	...	44
Barbados	...	...	...	...	...	3
Surinam	...	...	...	...	...	1
India	...	...	...	...	...	2
						50

TABLE IV.

Approximate length of time the disease has existed.

1 year and under	...	...	...	...	...	3
2-3 years	...	...	...	...	...	5
4-5 „	...	...	...	...	...	18
6-8 „	...	...	...	...	...	17
9-12 „	...	...	...	...	...	6
over 12	...	...	...	...	...	1
						50

TABLE V.

Length of time under Nastin Treatment.

Full 3 months' injection with 1 month more quiescence	33
Full 3 months' injection with no quiescent period	11
Full 3 months' injection not completed	1
50	

TABLE VI.

Type of Leprosy.

Nodular	...	...	...	...	...	42
Mixed	...	...	...	...	...	8
Anæsthetic	...	...	...	...	...	0
						50

6. As Professor Deycke has particularly directed attention to the destruction of the bacillus of leprosy as the object and achievement of the nastin treatment, my observations have necessarily been particularly engaged with this aspect of the patient's condition.

In each case lepromatous nodules were incised, tissue removed, and fluid from the cut surface smeared on slides for examination. In each case the fæces, urine, saliva, and nasal mucus were examined microscopically for the presence and the condition of leprosy bacilli.

The condition of the bacilli of leprosy were studied in section, and as smears on slides after staining by Gram's, the Aniline Safranin, and Ziehl's methods.

7. Where destruction of bacilli (bacteriolysis) was proceeding some idea of the proportion of destruction taking place was always recorded, and though necessarily only a rough estimate, yet it will indicate in some measure the extent of effect nastin can produce. While the bacilli in the nodules of lepers not treated by nastin are undergoing destruction, since the bacilli are not immortal, no such extensive destruction as 25 per cent. or 50 per cent. has ever been observed in the control specimens.

TABLE VII.

Showing extent of Bacteriolysis taking place.

Cases recorded as 25 per cent. or less of bacilli seen undergoing destruction	...	...	...	...	...	25
Cases recorded as 50 per cent. of bacilli seen undergoing destruction	...	...	...	...	...	12
Cases recorded as 75 per cent. of bacilli seen undergoing destruction	...	...	...	...	...	6
Cases recorded in which hardly any normal bacilli were found	...	...	...	...	...	7
						50

In connection with the above table, it is necessary to recollect that of the 50 cases, 33 were at the time of examination not receiving injection of nastin, being in the first quiescent period.

8. As regards the actual process of bacteriolysis, Professor Deycke states "the bacteriolytic process appears in two different types."

"In the case of Ziehl's staining there becomes perceptible either a gradual diffuse fading of the red colouration, until the bacilli appear to be hardly stained at all or tinted in the blue contrasting colour, whereupon they will be soon effaced by complete decomposition. Or—and this seems to be the more frequent and properly classical process—there first appear colourless gaps in the intense red-stained bacilli nuclei, the well-known segmented forms resembling cocci chains appear; then the cohesion between the still red, therefore fat-containing, bacilli parts is lost, the remaining fragments and granules crowding together forming more or less voluminous masses which at first still stained distinctly, are gradually discoloured, and at last disappear completely." (Lepra Vol. VII., fasc 3.)

The first type with gradual diffuse fading has only been observed in one instance, in all other cases when bacteriolytic changes have been observed they have taken the form of the second or "classical" type.

9. A careful examination of sections and of the films prepared from the leprotic nodules appears to indicate that one of the earliest effects of the injections is to destroy the cohesion of the bacilli, and to split up their typical arrangement in clusters, scattering them more uniformly over the microscopical field.

The cells filled with brown granules (globi) are readily found; it is difficult to say whether they are increased or decreased in number.

10. Examination of the fæces showed that the bacillus of leprosy was absent in 47 cases and present in 3.

In these three instances the bacilli appeared intracellularly in clusters, and showed no signs of degeneration. It is remarkable that these three cases show very marked improvement under the nastin treatment.

In six other of the 50 cases, bacilli which retained the carbol-fuchsin stain after decolorisation with acid were present in the fæces. They were short, blunt-ended bacilli frequently containing spores. They have been found in fæces of non-leprosy persons of this Colony.

In the saliva, the bacillus of leprosy was detected four times, the presence of these bacilli in the saliva were not associated with any change in the condition in the patient, nor did they show any signs of degeneration. Two out of those four cases were suffering from chronic laryngitis induced, no doubt, by the presence of lepromata in the larynx.

In the nasal mucus, leprosy bacilli were found 43 times, being absent in 7 cases.

Generally the bacilli were very evident both intracellular and extracellular, lying in clusters and scattered singly. Signs of destruction were observed in the bacilli from 3 cases, but in no instance to an advanced degree. It is remarkable, however, that even early signs should be noted, since the bacilli, though lying within the patient in the sense of being within the nasal cavity, are really outside the patient's body since they are lying in the mucus on the surface of the nasal mucous membrane, and not in the tissues of the nose, and subject to the circulating juices of the body.

11. In no instance were leprosy bacilli detected in the urine.

Albuminuria was present in 15 cases, or 30 per cent. The clinical symptoms of Bright's disease occurred once.

It is difficult to ascertain the effect of nastin injections on the condition of the kidney. The presence of albuminuria in 30 per cent. of the patients is noteworthy. It will be recollected that Dr. Hillis, of this Colony, stated in 1881 that "albuminous nephritis caused 22·5 per cent of all deaths among tuberculated patients, this disease being a fatal complication." (Leprosy in British Guiana by J. D. Hillis, 1881, pp. 39-40.)

This statement might seem to show that 30 per cent. would not be a large percentage when dealing with tuberculated lepers. However, Dr. Hillis proceeds to write "Albuminous nephritis is ushered in with feverishness, pain in the loins, and a sudden increase in the severity of the leprosy symptoms, the face and lower extremities become œdematous; albumin appears in the urine, which later on may be found to contain blood corpuscles and epithelial casts. This complication rapidly proves fatal; a few cases become chronic, but the respite is only a short one." (Ibid, p. 40.) The albuminuria here considered has evidently little to do with the albuminous nephritis of Dr. Hillis, nor is it connected with amyloid disease of the kidney due to mutilations with septic absorption.

Further investigation will, no doubt, throw light on this important point.

12. Though observations have been made more especially on the bacteriological aspect of nastin therapy, yet attention has also been paid to the changes proceeding in the morbid products which are excited by the leprosy bacilli. In considering this aspect of the effect of nastin, it is necessary to distinguish between anæsthetic and nodular leprosy. In attempting to estimate the changes achieved in anæsthetic leprosy, the observer is almost wholly dependent on the subjective symptoms of the patient. The distribution and extent of anæsthesia and analgesia cannot be defined with the certainty which the quick and accurate perception found in temperate climes allows, and it did not seem advisable to record any changes of sensation unless very marked and apparent.

13. There seems, however, good reason to note that in 8 cases large areas of originally anæsthetic skin have become hyperæsthetic, or have returned to normal sensation. The anæsthesia in 3 out of these 8 cases was due to true nerve leprosy while in the remaining 5 the anæsthesia was co-extensive with massive nodular leprosy. Many other patients were ready to point out areas where sensation was returning, but the statements were too ill-defined, and the failure to respond to different sensations too marked to warrant recording these. In some cases it was possible to observe that the colour of the leprotic areas deepened and subsequently became lighter.

14. In the examination of cases of nodular leprosy, it is possible to make observations on the changing characteristics of the hard infiltration. The changes produced by nastin may be classified into 4 groups:—

- (1) That in which no change can be detected.
- (2) That in which a gradual but obvious softening steals over the infiltrations.
- (3) That in which definite nodules soften and become liquid appearing as a bluish coloured soft blob which finally bursts, and discharges for two or three weeks, and then dries up leaving nothing but a scar.
- (4) That in which a specific febrile reaction occurs. Apparently, after several injections have taken place, fever with general symptoms begins; the temperature remains raised for three or four days during which period the nodules rapidly begin to pass through the stages mentioned under group 3.

TABLE VIII.

Showing the changes observed in the superficial deposits of cases of Nodular Leprosy.

Group 1—								
No change	...	...	...	...	...	...	...	32
Group 2—								
Softening	...	...	...	...	...	...	...	9
Group 3—								
Destruction of the nodule	...	...	...	...	...	...	...	5
Group 4—								
General reaction	...	...	...	...	...	...	...	2

In four cases the softening and scarring are so advanced as to show change to the naked eye. It is remarkable that of these four the two showing the greatest improve-

ment both had the general reaction of group 4, while the remaining two are of group 3. Moreover, the greater the destruction of the leprosy bacilli as noticed in paragraph 7, the greater is the softening and naked eye improvement. The femoral glands which were enlarged in all of the cases with one exception showed no softening, tenderness, or other change.

15. Four microphotographs* are attached to show the nature of the destruction which the leprosy bacilli undergo. I regret that the photographs are not more clear, but the absence of expert assistance in photography at high magnifications, and the lack of an accurate instrument, have thrown me on my own resources.

16. In concluding, it is right to call particular attention to the facts, firstly, that the cases of leprosy treated by the nastin treatment were largely of a severe nature, and prolonged existence; secondly, that the cases reviewed in this report had only received a portion of the treatment prescribed by Professor Deycke.

9 July, 1909.

K. S. WISE.

No. 3.

BRITISH GUIANA.

PROFESSOR DEYCKE to COLONIAL OFFICE.

(Received 4 October, 1909.)

MY LORD,

Hamburg, the 30th July, 1909.

ON my return from British Guiana I consider it my first duty to render you an explicit report on my work out there and the results I obtained.

I have been working in British Guiana altogether five months—from the beginning of December, 1908, to the beginning of May, 1909. The Leper Asylum at Mahaica, which was so very kindly placed at my disposal by the Colonial Office and the Government of British Guiana in order to carry out the therapeutic trials of my own method of treating leprosy, contained 430 to 440 lepers of the most varied forms and stages of the disease. The material at my disposal was, therefore, very plentiful, and hence most suited for clinical-therapeutic observations and examinations on a large scale. I have in all 111 lepers, 69 male and 42 female, treated for an extended period. I did not select these patients but adopted them just as they offered themselves, hence I have been enabled not only to study the influence of my method on all forms of leprosy but also on all grades of the disease. From the attached photos,* to which I shall refer at greater length hereafter, one can see at once that amongst the cases treated there were those of a most severe nature, of which *a priori*, for anatomical reasons alone, a decided improvement could scarcely be hoped for. Although, I should like to point out, that by far the larger number of my patients, especially those belonging to the so-called skin or nodular form of leprosy, had suffered from the disease for many years, and hence were in a very advanced and severe stage.

The treatment consisted solely in the application of subcutaneous injections of my remedy called "Nastin." The injections were applied, without exception, once a week, commencing with weaker and then advancing to higher concentrated doses. I specially beg to point out that all other therapeutic applications of a surgical or caustic nature or any other external remedies have been entirely avoided. I did this for the purpose of meeting any remarks to the effect that the results obtained might be due less to my injections than to these therapeutic applications; but beg to state here, that such surgical, &c. treatment may, under certain circumstances, be most valuable. In the interest of severest objectivity, I considered myself bound even to abstain from trial incisions for bacteriological and diagnostical purposes, but simply extracted for my microscopical examinations a few drops of the sap from the lepromæ by puncturing same.

The injections of the remedy—a bacterial fatty body called "Nastin," in oily solution combined with a chemically very active substance, benzoyl-chloride—at first cause a certain pain, which, however, disappears after a few minutes, but, if carried out *lege artis* and according to my instructions, produce no other unpleasant or detrimental effect on the tissue at the injection point. This is fully corroborated in my recent trials, where more than 1,500 injections have been made. Only through the application of a somewhat higher concentrated solution, which I prepared

* Not reproduced.

myself in British Guiana, some small but unimportant abscesses were formed, which must be adduced to the decomposition of benzoyl-chloride by the maximum dampness of the air in this tropical country. As this fault was never observed after injections from the hermetically sealed tube solutions prepared at the factory in Germany, the method proves to be faultless also from the technical point of view.

In previous years, before I knew the proper dose and the suitable proportion for the mixture of nastin and benzoyl-chloride, I had always to take reactions into consideration. The reactions were of a local or general character, in the first instance, such as inflammation, matter or necrosis—process of the leprous tissues, whilst secondly, they resulted in fever, subjective ill-feeling, &c. As such reactions are not without danger for the patient, I did not pronounce my method to the general practice until I felt able to avoid such severe reactions by a suitable concentration of the remedy. This surmise is absolutely confirmed by my trials in British Guiana, where it was shown that the selected dose on the one side does not produce any severe or dangerous reactions; on the other hand, however, the same proved strong enough to secure the remedy a satisfactory effect. In fact, during my treatment at Mahaica, only in a very few cases, 8 out of 111, slight general reactions have occurred, which, however, in *no* case approached anything of a dangerous character. Hence also in this respect the method cannot be regarded as faulty. If the instructions are strictly observed any danger for the patient is absolutely excluded; this I can firmly assure on hand of my very extended experience.

I now wish to refer to my clinical observations, during my treatment of 111 lepers at Mahaica.

At the commencement I wish to state that one of the patients died, but, as is shown by the following details, this was neither due to my treatment nor was it caused by leprosy. The case in question was one of slight nervous leprosy, which showed only slightly extended anæsthesia and a spotty exanthema over the whole of the body. During the treatment, which, as in all other cases, was interrupted after $3\frac{1}{2}$ months, the anæsthesia had improved and the spots nearly disappeared, only leaving small traces. Fourteen days after the cessation of the treatment the patient suddenly became ill with high fever, which became complicated by breathing difficulty, heart insufficiency, and lungœdema. He died; and in the post-mortem an acute, fresh, feverish, pussy pleuritis and pericarditis was observed. A leprous disease of the internal organs could not be ascertained. Hence the patient died of an acute infectious disease, which had nothing whatever to do with leprosy.

Apart from this case no aggravations in the specific leprous process have occurred during my time of observation. Only one affection, though only apparent, makes an exception therefrom, viz., the inflammation of the eyes, so frequent in lepers, to the danger of which, in respect to the vision, I have already referred in previous publications. I beg expressly to affirm that these cases are not those of purely eye-leproma. Such really leprous affections, so long as they are free from inflammatory appearances, can well be reduced by the Nastin Therapy. I refer here, on the contrary, to inflammatory processes of the cornea, iris, &c., which are in most cases of a secondary form, *i.e.*, they are not of a purely leprous nature. As nastin, especially in higher concentrations, produces inflammatory reactions, already existing inflammatory changes on the eye may be increased by nastin, and can thus somewhat endanger the vision. In such cases, which fortunately are very rare, one is indeed in a deplorable dilemma. On the one hand the disease of the other part of the body demands higher doses of nastin, whilst at the same time the inflammation of the eyes prohibits the application of even the classical, *i.e.*, the dose usually employed at the commencement. In some cases the eyes may be even so irritable that the very slightest concentration of nastin is prohibitive; in such cases, and on hand of my recent experience, I can only advise an interruption of the nastin treatment altogether, until, by other measures, especially of an operative nature (Iridectomy), the inflamed eye is so far freed from the inflammatory appearances and the great danger of the secondary glaucoma, so that there is no longer any opposition to a careful nastin treatment. In fact, in four of the cases under treatment at Mahaica such occurrences have been observed, and in these cases, which, however, otherwise reacted very well to the nastin treatment, the therapy could only be carried out with difficulty and with frequent interruptions. In one case, I was compelled to suspend the treatment for a longer period. Apart from these eye-affections, no aggravation of the leprous symptoms have occurred. I must however, make mention of one other case, which, during the treatment—although in my opinion not on account of the treatment—showed aggravating symptoms of

the general condition. This patient, who suffered from a very severe tuberculous leprosy, but who was well inclined for the nastin treatment, which was indicated by the inflammatory reactive changes of the leprosy symptoms, as well as by the extended bacteriolytic processes of the lepra bacilli, showed from the beginning a great increase and swelling of the spleen and liver, which, in view of the anamnesis was undoubtedly due to complicated malaria. All at once the patient developed an acute kidney inflammation, and although the treatment was at once interrupted, it was impossible to materially improve the severe general condition of the patient. I firmly believe that in this case the aggravation was due to a severe malarial affection, the more so, as in another case of fresh, *i.e.*, not too far advanced, tuberculous leprosy, I could ascertain that a clinically undoubtedly proved (by fever curve and quinine treatment) malaria infection acted most damagingly on the organism affected by leprosy and the influence of the nastin treatment. Of course, this does not occur in all cases; at least, I can show one instance of a very severe and advanced leprosy which simultaneously suffered from extended malaria cachexia with severe enlargement of liver and spleen, and in which case not only the leprosy symptoms improved, but also the appearances of the chronic malaria, and the liver and spleen swellings especially were greatly reduced. Nevertheless, it is clear that a disease like malaria, so detrimental to the organism, is not suited to support the effect of a specific leprosy-therapy, and it will therefore become necessary to pay special attention to this combination, so frequent in tropical countries, when estimating the value of the therapeutic results.

After these preliminary references I wish to describe the therapeutic results of the nastin treatment during the time I was in British Guiana. To be able to arrive at a clear picture of the material at my disposal, I propose to divide the cases as follows:—

1. Tuberculous or nodular leprosy.
2. Anæsthetic or nervous leprosy.

In both large departments the following subdivisions have to be made:—

- 1a. Purely tuberculous leprosy, *i.e.*, such cases in which the leprosy process takes place exclusively on the skin or the visible mucous membrane.
- 1b. Predominant tuberculous leprosy, which is, however, more or less mixed with nervous symptoms.
- 2a. Purely anæsthetic forms of leprosy, *i.e.*, all cases in which the leprosy process is exclusively located in the nervous system.
- 2b. Predominant nervous leprosy with nodular symptoms combined.

Of group No. 1 I had altogether 81 cases at my disposal, of which 66 showed also nervous symptoms to a greater or lesser extent.

Of the second group of nervous leprosy I treated altogether 30 cases, of which four showed likewise leprosy of the skin, although in a very slight degree.

Hence, to the great group No. 1, 81 cases belong, of which 15 cases belong to group No. 1a and 66 cases belong to group No. 1b.

To group No. 2, 30 cases belong, of which 26 cases belong to group No. 2a and 4 cases belong to group No. 2b.

Before I refer to the purely numerical part of the results of the treatment, I think it necessary to speak about the kind of treatment to which I subjected them.

The injections were carried out only once a week, as I already mentioned above. I commenced regularly with 1 ccm. of nastin B₁, with the exception of a few cases in which inflammatory eye affection existed, and which made the application of very weak concentrated nastin B₀ necessary. As generally the reaction of my patients at Mahaica—to which I shall refer at length later on—was considerably less than I had previously experienced in Turkey, I could on an average, after 5-6 weeks, revert to higher and, as it appeared to me, more effective doses of nastin B₁. In a number of patients I have at the close of the treatment even used still higher concentrated nastin solutions without experiencing the impression that by this therapeutically more was obtained, or the reaction was increased remarkably. On the whole, I may say that I have chosen the correct concentration in my standard solutions B₁ and B₂. Perhaps, with one exception, that in many cases it is possible, quicker than I anticipated by my previous results, to revert to the higher dose B₂. My observations in British Guiana lead me altogether to the

conclusion that in principle we have to deal with an immunizing treatment, at least in the sense that in time the bacilli become accustomed to the remedy, so that after some time even higher concentrated doses, which in the beginning might easily lead to severe reactionary appearances, are now easily endured. Although this has the benefit of avoiding severe reactions by gradual increase of the dose, on the other hand it plainly shows that it is not advisable to continue the treatment uninterruptedly for many months or years; on the contrary, it is advisable after about three months to suspend the injections for 2-3 months and then to take up the treatment afresh. Practice as well as theory has induced me to advise the nastin treatment in the form of a chronic intermittent therapy, similar to that of mercury in lues. At any rate, I know that in such cases where the process of improvement comes to a standstill after a time, a forced nastin treatment, by either more frequent or stronger concentrated injections, does not lead to any success, but that, on the other hand, if after a fair interval the remedy is suddenly given again in the old dose, further progress and improvement and even slight reactive appearances take place; consequently, I was induced to interrupt the treatment of my patients at Mahaica after 3-3½ months. The patients have, therefore, only received a maximum of 16 injections; many of them only 11 to 14 injections, and some, who only began with the treatment later on, consequently less.

After this necessary divergence, I refer to my statistical figures regarding the obtained results, viz. :—

In group No. 1, of 73 cases =	90.12	per cent.
" " 2 " 30 " =	100.00	"
In sub-division 1a, 11 " =	73.33	"
" " 1b, 62 " =	93.94	"
" " 2a, 26 " =	100.00	"
" " 2b, 4 " =	100.00	"

in all of 103 cases = 92.79 per cent. improvement could be observed.

If I speak about improvements, it is natural that in the short time of treatment of only 3-3½ months no definite results could possibly be attained. In such an exceedingly chronic disease as leprosy it is absolutely necessary to continue the treatment, at intervals, for several years. The results are, therefore, according to their degree very varying. The difference not only depends on the age and the severity of the disease, but also on the individual condition of the patient. Without doubt there exist lepers who *a priori*, for reasons so far unknown, are much more inclined to improve and to react more promptly to the treatment than others, and it is not at all seldom that relatively fresh, that is cases in an early stage of the disease, are much more difficult to improve than others which are more advanced. Under these circumstances, it cannot be wondered at that in the material at my disposal, the results were not at all uniform. There are, as I already mentioned, some few cases which do not show any improvement at all; in others the improvements could only be noticed by exact clinical and microscopic examinations. Apart from those cases which were not improved at all and others which were only a little improved, there were a number of cases showing varying degrees of improvement up to cases which were absolutely changed in appearance, so that the improvements could easily be observed by the naked eye.

The changes in the tuberculous or skin leprosy were not most remarkable. In conformity with previous observations I could notice that this form of real tubercle, *i.e.*, that form which, owing to the localisation on the surface and the deforming character is most conspicuous, was often not the most influenced by the treatment. This undoubtedly partly depends on purely anatomical conditions. At any rate, from the repeated observations, it seems to be clear that sharp, circumscribed, and hard nodular forms behave in a most refractory way, whilst more diffuse, soft and less sharply circumscribed leproma and even extended leprous infiltrations may sometimes very promptly react to the treatment and quickly reform. However, the form which most quickly reacted to my treatment in the cases in British Guiana and in which the effect was most certain, was that of deep swellings on all the extremities, which, in very advanced forms, approaches almost the well-known elephantine enlargements of the limbs. These deep swellings, which really represent the seat of the leprous process (for leprosy is undoubtedly a primary disease of the lymphatic system and the formation of leproma is a secondary local process) were in nearly all cases very favourably, and sometimes even surprisingly,

influenced. The reduction of these specific swellings not only explains the frequently observed decrease in the volume of the legs and arms, but, as can also be seen in some of the photographs with great preciseness, a total change of the face and its expression, which can quite easily be noticed by a careful examination of the photos. The previously swollen—and hence broader—face becomes, in consequence of the treatment, more elongated again, and is rendered much more expressive and human, even if no remarkable improvement has taken place in superficial leproma.

I believe that these short explanations of the symptomatology of the tuberculous leprosy under the influence of the nastin treatment may suffice as the photos will show better than words the degree and character of the changes obtained. To these photos I add a special description of the various symptoms and their influence by the therapy. I should, however, like to mention more extensively an important point which is chiefly in question in the nodular form of leprosy, viz., the effect of the nastin on the lepra bacilli. In previous publications I have explained that nastin B acts on the lepra bacilli in the sense of depriving same of the protecting fatty substance, and hence renders the originators of the disease ready for dissolution and destruction by the normal bacteriolytic powers of the body; hence nastin effects indirectly, though not directly, a bacteriolysis of the lepra bacilli, and, on hand of my large material of more than a thousand microscopic examinations, I could confirm most clearly and explicitly all my previous observations regarding the degree and the form of these dissolving processes on the lepra bacilli. Naturally, I only speak of bacteriolysis if, in a certain leprous formation the majority of the originators—present often in almost incredible numbers—appear dissolved in this characteristic way. Partial bacteriolysis is, of course, found even in cases not treated at all, especially in somewhat older leproma, and I believe I am right in assuming that this spontaneous bacteriolysis, without which a spontaneous reformation of the leproma would not be possible and explainable, and which sometimes occurs, is qualitatively the same as the nastin bacteriolysis, which, however, quantitatively differs from this spontaneous reformation.

I may further mention here that it is impossible to obtain bacteriolysis in all leproma after only three months' treatment. In this stage of the treatment there are often leproma present which are quite unaffected bacteriolytically. I believe this is an advantage; for, if the bacteriolytic process extended in such a short time to all bacilli of the whole body, it could often and easily happen that in spite of the low toxicity of the lepra bacilli, dangerous and even lethal symptoms appear.

Hereafter I should like to remark that the bacteriolysis was observed in such a proportionately high percentage that it far surpassed my expectations. I distinguished from bacteriolysis in the purely tuberculous and analogous process in the bacilli present in the mucous membrane of the nose, and should here make another remark interesting for the reason that in all tuberculous lepers which I treated the bacilli were found *in every case* in the nose, whilst in the instances of nervous leprosy only in six cases. Bacteriolysis in the nose could be observed in 27 of the cases treated, that is in 31 per cent., whilst bacteriolysis in the leproma was observed in 68 out of 80 cases, *i.e.*, 85 per cent.

One can see, therefore, that the results of the microscopic examinations, which, in a specially instructive way demonstrate the specific influence of the nastin therapy on the lepra bacilli, are most favourable, especially if one considers that, in accordance with experience, the lepra bacilli in the nose are able to resist to the greatest extent for a very long time, sometimes even for years, even in cases which have been clinically improved.

In anæsthetic cases, of which I had 31 under treatment, in every case, without exception, marked improvement took place. The results here are so uniform and in their consistency so surprising, even beyond my expectations, that in this form of leprosy, for clinical reasons alone, the specificness of the remedy has been proved most clearly, not only by the regularity of the results, but also by the promptness, and, partly, even extraordinary extension, of the improvement. In about ten of the cases, that is one-third, it has been observed with certainty that already after two or three injections of nastin B₁, marked re-formations of the anæsthetic or other nervous symptoms were ascertained. As regards the degree and extent of the improvements they are naturally subject, also in the nervous leprosy, to the great difference in the various individual cases. Nevertheless, the improvements here are more steady and not so arbitrary or irregular as seems to be the case in

nodular leprosy. One can here, on hand of anamnestic informations and clinical researches, easily arrive at some clear conclusions as to why in one case the effect is more extended and striking than in other cases. A very remarkable factor in regard to this seems to be, in view of the histories of the disease in my patients, the age and stage of the disease. In relatively fresh cases, *i.e.*, of only a few years' standing, I noticed that anæsthesia, even of the greatest extent all over the body, has been reduced with surprising celerity and disappeared, leaving only relatively small traces. On the other hand there are a number of cases of much longer duration, namely, on an average 6-10 years, with comparatively slightly extended anæsthesia, where, although they have been improved during the treatment, yet only to a more or less limited extent. The reason for the different results on the various cases—which difference is quite concurrent with the difference in the age of the disease, is very simple and striking, namely, where the nervous fibres or rather the nerve cells have been definitely destroyed by the intensity and duration of the leprosy disease, one cannot expect the restoration of the functions; the loss is therefore irreparable. What is correct so far as anæsthesia is concerned refers also to other nervous symptoms. Nevertheless, the improvements in these cases are somewhat less extended and prominent than those of anæsthesia, and it appears to me that motoric nervous lines are more vulnerable and subject to total destruction by the leprosy process. Notwithstanding, I can show in nearly all cases of contractions of the joints, paralysis, motoric nerves, &c., causing functionary disturbances, that during the nastin treatment the functions of the damaged parts of the body, for instance, the working ability of the hands, the use of the feet, &c., were greatly improved—and often in a remarkable way. I should further like to mention that also purely trophic disturbances are very favourably influenced, and I would especially mention those perforating ulcers which resist almost any therapy, and of which a large number in the short time of treatment have been healed or at least brought near to healing. In those trophic ulcers, however, where healing or improvement did not set in, I could always prove that the healing of the deep, crater-like or fistula-like ulcers was prevented by the necrosis of bone.

Lastly, I should like to state that the therapy always acts promptly on the spots of the skin, which are so prevalent in nervous leprosy, in the sense of a reduction, or respectively, the restitution of normal pigmentation.

Bacteriolytic processes were, for obvious reasons, only observable in rare cases of nervous leprosy, but clinical observations, as I may again mention, speak, without exception, for the specific effect of nastin, and in this so frequent form of leprosy in which any other specially external application cannot come into question, the nastin therapy is the most effective in our hands, and I do not doubt that if the cases of nervous leprosy are treated early enough, and with the necessary experienced care, with nastin, a large number of these unfortunate human beings may be preserved from mutilation and other severe lesions. I even believe that after a longer treatment with nastin, not a few of the nervous patients can be restored to the human community, especially as most of them do not show any lepra bacilli either on the skin or in the nose.

If, in conclusion, I draw the facit of my five months' therapeutic work in British Guiana, I can safely put down the following statements, which I have, however, already previously pronounced and which I have now proved on the larger number of patients and found fully corroborated, *viz.* :—

- (1) Nastin B is a specific, that is, a directly effective remedy on the leprosy originator.
- (2) By means of the nastin therapy in most cases of the treated lepers, after the relatively short time of 3-3½ months, more or less extended improvements of the leprosy process in all its different forms and appearances could be obtained.

I will not refer to any previous experience in the nastin therapy, which extended for a much longer period than a few months, nor will I cite any other practical results which by other researchers in different countries, for instance, Russia, India, West Africa, &c., have been obtained with my method of treatment of leprosy and reported upon, and lastly, I will not draw any conclusions from the above-mentioned statements. If, therefore, I strictly adhere to the positive remarks in these statements which have been proved by the results of my work in British Guiana, it will undoubtedly follow that by the introduction of nastin into the practice of the treatment

of leprosy a decided progress, not only in the therapy but also in the combating of this dreadful disease, has been created.

For, as regards the first point, there is no doubt that practical scientific proof has never been brought forward in such a large material, that any other general treatment of leprosy, and such nastin is really, acted specifically or brought about anything like the high percentage of improvements. The legion of not generally, but externally, effective remedies which have been recommended against leprosy and which are employed, I do not need to refer to, for in the one case they are only applicable to skin symptoms of leprosy and leave the deeper processes of the tuberculous form as well as the whole and extensive sphere of the nervous leprosy untouched. But even if I take into high consideration these external remedies and methods, and even if I were convinced that in certain cases good results could be obtained, they are still useless for the purpose of a general fight against leprosy owing to their expense and the large apparatus of medical attendants, warders, instruments, &c., which undoubtedly are not suited to the ordinary leper asylums.

The treatment and cure of single cases is not the point in question at all, and with this I come to the second part, viz. :—

The fighting of leprosy as a public disease.—Anyone who has studied the leper question and seen its dark side with his own eyes as it is exposed to the observer in the tropics, will be convinced with me that, with the introduction of obligatory isolation by law, it is not, by a long way, sufficient. In countries like British Guiana, for instance, in spite of the best law and intentions on the part of the authorities, the compulsory isolation of the lepra bacilli will remain a *pium desiderium* until the patients are not only internated but also treated with hope of success. So long as this is not the case there will always be a large number of lepers—particularly lepers of a slighter degree and less noticeable and hence doubly dangerous subjects for spreading the disease—who will know how to evade isolation.

A method of treatment, however, which shall be combined with a strictly-carried-out compulsory isolation must justify a certain number of requirements, viz. :—

- (1) The method must be simple so that it can be carried out in the present asylums without any special personal expenditure, &c.
- (2) It must not be too expensive, for it means a treatment on a large scale.
- (3) The method must convince the patient that it is really useful and helpful to him to be saved of the dreadful disease, and, if not to cure, at any rate to improve his condition and prevent a further advance of the leprous process.

After the whole contents of my report it is not necessary to refer to the question as to whether the nastin therapy for leprosy fulfils these requirements. I myself am firmly convinced of it, and I therefore beg to refer to the propositions which I had the honour to make in March of this year to His Excellency the Governor of British Guiana.

Lastly, I have to perform the pleasant duty of expressing my best thanks to the Colonial Office, the Colonial Government, and the medical gentlemen and officials in British Guiana, not only for the great interest they have shown in my work, but also for the very great assistance and kindness I have experienced during the whole of my visit to Demerara.

I remain, &c.,

PROFESSOR DR. DEYCKE.

No. 4.

BRITISH GUIANA.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 15 November, 1909.)

MY LORD, Government House, Georgetown, Demerara, 30 October, 1909.

I HAVE the honour to transmit, in duplicate, a report by Dr. K. S. Wise, Government Bacteriologist in British Guiana, on tropical diseases research work done in the laboratory during the half-year ended the 30th September.

2. I am advised that Dr. Wise, who is now absent from duty on account of

ill-health due in a great measure to overwork, has been unable to accomplish more research work than is shown in the report owing to the many other duties which have claimed his attention. The material for the work is available, and only awaits the time and opportunity to unravel it, both of which will, it is hoped, be afforded with the arrival of the assistant bacteriologist whom your Lordship has been asked to appoint.

I have, &c.,
F. M. HODGSON.

Enclosure in No. 4.

REPORT OF THE GOVERNMENT BACTERIOLOGIST, BRITISH GUIANA, ON TROPICAL DISEASES RESEARCH WORK, FROM APRIL, 1909, TO SEPTEMBER, 1909.

SAND FLIES.

These have been collected as opportunity allows and comprise specimens from Georgetown, Mahaica, Mahaicony, and New Amsterdam.

Two species are present and belong to the family Chironomidæ, genus *Ceratopogon*.

This insect has also been found and identified in St. Vincent, West India Islands. It is there described as "the common sand fly about the southern end of the Island, but is not very troublesome. Bites late in the afternoon before sunset; sometimes during the heat of the day." This description corresponds very closely to the habits of this insect in this Colony. They usually appear in a swarm just before sunset and gradually disappear as the night progresses. Usually houses are avoided by these insects, but sometimes they will remain in a cottage or house and continue biting all night. I have been bitten by them during the middle of the day. The bite is a particularly painful one, since the irritation remains for a long time after the insect has had its fill and departed. Though these sand flies will often prefer to bite one individual rather than another, there appears to be no process by which the older resident becomes accustomed to the bites of these flies, such as occurs in the case of mosquitoes.

I. *Ceratopogon phlebotomus*.—This is the common biting sand fly of the Colony. It has been found in myriads in New Amsterdam, Rossignol, Mahaicony, and rarely at Mahaica and Georgetown. The female insect measures 1·3-1·8 millimetres long. The head is light brown and has two large, smooth, reniform eyes. The palps are short and of four segments. The antennæ are slightly shorter than the thorax and consist of fourteen segments. Sparsely arranged hairs surround the base of each segment. The last four segments are rather longer than the proximal ones.

The thorax is dark brown and convex, but does not cover the head. It shows no marking, though the mesonotum is slightly yellowish.

The abdomen has eight segments and is dark brown with darker lateral areas to each segment.

The legs are light brown. The coxa and femur are almost bare of hairs. The tibia, metatarsus, and tarsus are freely covered. There is a downwardly directed spine at the distal end of each tibia of light yellow colour. The metatarsus is much longer than the succeeding segment and is equal to the next two or three tarsi. There is no pulvillus. The tarsal claws are equal and single.

The wings are faintly brown and have hairs arranged around the edge; a few occasional ones appear at the end of the wing. The wing is covered by short fine spinules.

There are light and dark markings and spots on the wings (*see illustration**). The most prominent of these is a dark spot at the tip of the costal cell.

The cubital vein meets the costa at its middle point. The subcubital vein fuses with the cubital nearly at its end. The discoidal vein bifurcates and is united with the cubital by a transverse vein. The postical vein is bifurcated. The second, sixth, and seventh veins are vestigial or absent.

II. *Ceratopogon maculithorax*.—This much resembles the foregoing species. It is, however, slightly larger; the female measures 1·8-2·0 millimetres, and in general is of darker colour.

The head is dark brown and differs from that of *C. phlebotomus* in that the

* Not reproduced.

second joint of the palp is thickened and the terminal joint of the antenna is constricted in the middle (*see* illustration).

The thorax is almost black. The mesonotum, however, is greyish with numerous black spots scattered over it. Few hairs are present. The pleuræ are very dark brown. The halteres are transparent and light yellow. The abdomen is deep brown and consists of eight segments. The legs are light yellow. The femora, however, have a dark brown shading over the greater part of the length. The spine at the distal end of the tibia is dark brown (light yellow in *Phlebotomus*) and is absent on the hind tibia. The metatarsus is as long as the three following tarsi.

The wings are hairy at the tip and along the costa, the cubital and third veins. They are maculated, the most prominent spots being two dark areas along the costa and third veins (*see* illustration).

ILLUSTRATIONS.*

- No. 1. Whole sand fly. *Ceratopogon phlebotomus*.
- No. 2. Antennæ, palps and proboscis of *C. phlebotomus*.
- No. 3. Antenna of *C. maculi-thorax*.
- No. 4. Wing of *C. phlebotomus*.
- No. 5. Wing of *C. maculi-thorax*.

PULMONARY STRONGYLOSIS.

This is a disease which I have found in specimens sent to the bacteriological laboratory from the abattoir in Georgetown. It is limited to the carcasses of sheep imported alive from American ports and is due to the presence of the Nematode worm, *Strongylus rufescens*, in the lung. This disease is usually developed in adult sheep.

It may show no symptoms at all in the animal; on the contrary there may be abundant bronchial discharge, coughing, anæmia, and wasting.

This disease at the abattoir is limited to the lungs and shows itself in two distinct forms:

1. A diffuse pneumonia due to the ova and embryos of *Strongylus rufescens* lodging by thousands in the general tissue of the lung leading to inflammation and exudation. This type of the disease appears as areas from 1-2 square inches in size which are hard, raised above the cut surface and of a dark red colour. Three or four of these may be found in one lung; they have, moreover, a tendency to coalesce and to form abscesses.

2. A nodular or pseudo-tuberculous pneumonia. In this form the ova and embryos occupy small circumscribed areas in the tissue of the lung, producing numerous small spots of hard inflammation. This very closely resembles miliary tuberculosis. It appears, however, that both verminous pneumonia and miliary tuberculosis sometimes co-exist.

This latter type of pneumonia is that which appears more often at the Georgetown abattoir. Numerous small nodules of the size of small shot are felt throughout the whole lung. They are greyish in colour, changing later to yellow and eventually becoming caseous and calcareous. These nodules are generally found nearer the surface of the lung than in the deeper parts.

Both these types of pneumonia in the lung of sheep are caused by the presence of ova and embryos which the adult female *Strongylus rufescens*, living in the bronchial passages, deposits in the pulmonary alveoli. Of the attached illustrations, No. 6 is a section of the diffuse type of pneumonia magnified 80 times to show its general exudative character, the ova are just visible; No. 7 is a section of the pseudo-tuberculous type magnified 200 times to show the embryos and ova *in situ*.

Scraping the surface of lung affected by this disease yields a frothy fluid in which numerous ova and embryos may be seen under a magnification of 200 diameters. The eggs are 75/1,000-90/1,000 of a millimetre, the embryos 300/1,000-400/1,000 of a millimetre in length.

Illustration 6.*—Section of diffuse type of verminous pneumonia magnified 80 times. Shows exudative character of inflammation. Ova just visible.

Illustration 7.*—Section of pseudo-tuberculous type of verminous pneumonia magnified 200 times. Shows embryos and ova of *Strongylus rufescens in situ*.

* Not reproduced.

CHYLOUS ASCITES.

It is extremely rare to find any description of post mortem examinations of this disease. I therefore take this opportunity of recording the results of a careful investigation in a case of chylous ascites which died in the hospital at Georgetown.

The patient was a female, aged 27, of black race and a native of British Guiana. She was admitted to hospital in April, 1908, complaining of an abdominal tumour and of shortness of breath. The swelling of the abdomen first began in December, 1907.

The abdomen measured in April, 1908, 48 inches at the umbilicus.

Three to four litres of fluid were withdrawn. This fluid was milky white and opaque, tinged slightly of a salmon pink colour. It appeared perfectly homogeneous. No coagulation took place on standing, but the fluid settled to three layers: thick cream at the top, whitish purulent layer at the bottom, and an intermediate thin, grey, nondescript layer. Microscopically the top cream layer showed a large quantity of granular irregularly shaped bodies (·0007 mm.-·0023 mm.) containing fat. No obvious circular, contoured fat globules were seen, such as appear in milk.

The bottom whitish layer consisted mainly of irregular, granular material probably hæmoglobinuric in origin; a few leucocytes were present. No adult or embryonic filarial worms were seen even after centrifuging large quantities of the fluid.

Chemically the fluid has a specific gravity of 1,037, was alkaline to litmus, and showed in 100 cc. alkalinity equivalent to ·21 gramme sodium hydrate. It was highly albuminous, and on boiling became almost solid. Fat was present to ·23 per cent.

The patient left the hospital in May, 1908, somewhat relieved. She returned to the hospital in November, 1908, and died in December, 1908.

The abdomen now measured 52 inches round at the umbilicus and 19 inches from the ensiform cartilage to the pubes. Fluid was obviously present in the abdomen, which did not, however, change relations on altering the patient's position. No other filarial disease present.

The fluid when removed was chylous as before. It was sterile and microscopically showed the same features as before. The Government Analyst (Professor Harrison) kindly undertook the chemical examination of the fluid and reported that the specific gravity was 1,025. Fat showed 0.113 per cent, mineral salts 0.87 per cent., and nitrogen 1.056. Chlorine was present to 0.31 per cent., equivalent to 0.51 per cent. sodium chloride; of phosphoric anhydride 0.017 per cent. was present. The quantity of nitrogen present is equivalent to 6.55 per cent. albuminous material.

Laparotomy was performed, the whole of the chylous fluid removed, and isotonic calcium chloride solution left in the abdomen. Death occurred from shock the day following. Post mortem examination revealed the presence of a large cyst occupying the whole of the abdominal cavity and confining the viscera to the pelvic and subdiaphragmatic areas.

Careful dissection of the wall of the cyst shows that it has been developed between the two layers of the mesentery, and is presumably a retention cyst caused by the obstructing of a lacteal area.

Illustration 8* shows the position of the cyst and its relation to the abdominal viscera.

Illustration 9* shows the probable mode of origin of this pseudoascitic condition.

No definite parasite or inflammatory process could be found at the mesenteric root to account for the obstruction. The wall of the cyst appears to lack an internal endothelial layer, it consists mainly of a fibromuscular layer containing unstriated muscle (see illustration 10*) and infiltrated by mononuclear cells. The superficial layer is connective and fibrous tissue and resembles thickened peritoneum.

Illustration 8.* Diagram showing the relation of the cyst to the viscera of the abdomen.

Illustration 9.* Diagram showing the probable mode of origin of the cyst.

Illustration 10.* Microphotograph of section of wall of the cyst magnified 350 times, showing unstriated muscular fibre.

CHYLURIA.

In "Tropical Diseases" (1907), by Sir P. Manson, it is stated on p. 627 under the heading pathology of chyluria, "When a lymphatic varix in the walls of the bladder or elsewhere in the urinary tract, the consequence of filarial obstruction in the thoracic duct, ruptures, there is an escape of the contents of the varicose lymphatics into the urine. Chyluria is the result."

The following case illustrates excellently the above conception of the causation of this disease, and is further interesting in that the patient died during the first attack of chyluria.

The patient was a male of black race, aged 36, born in British Guiana. He complained of blood in the urine, which had been continuously present for three weeks. He had, further, a cough and pain in the left side of the chest. After nine days in hospital, death occurred from a left empyema. The urine passed during his stay in the hospital was deep red and had a large deposit of obvious blood. Red blood corpuscles were present in enormous quantities; no filarial embryos were to be seen. It is usual to find filarial embryos in chyluria in this Colony in about 70 per cent. of such cases.

No fat globules were found.

The patient stated that he had never had red or white urine at any time until this present attack. Frequently clots of blood were expelled, with some pain, before the urine flowed. The urine itself was full of blood as it flowed from the penis.

Hæmaturia has now been recognised here as a frequent antecedent of chyluria, and an estimation for fat was proceeded with and showed 0.030 per cent.

The post mortem examination was performed one hour after death and showed a large empyema of the left side. The left lung was, of course, collapsed, and with the exception of the kidney the other organs were natural.

The area between the kidneys behind the peritoneum was filled by a tortuous mass of lymphatics which extended into the mesentery, but more particularly down over the spine towards the pelvis, and reaching to its brim (see illustration 11).

These lymphatics contained no pus, but were filled with a thin reddish fluid which escaped readily from the cut vessels. The urine extracted from the bladder showed 0.200 per cent. of fat with a large quantity of blood. This specimen of urine showed much more resemblance to chyluria than the samples obtained during life.

Careful dissection of the interrenal mass showed that while it could be readily separated from the left kidney and ureter without breaking any anatomical connections, the lymphatics composing this mass were closely applied and in communication with the upper part of the right ureter. The pelvis of the right kidney and its ureter were filled with blood, while the left ureter showed no traces of blood whatever. Scattered throughout this mass were numerous small cysts, half-inch diameter, filled with chylous material showing large globules of fat. Lymphatic glands were incorporated also in this interrenal mass, to which lacteals ran, and on section these glands showed the reticular spaces much more pronounced than usual, as though distended by fluid (see illustration 12).

Fresh sections of these glands stained by osmic acid showed small globules of fat in the distended spaces; no large globules were seen.

The pancreas was normal on microscopic examination. Sections made through the right ureter near the renal pelvis (including the attached lymphatic mass) reveal dilated lymphatics anatomically continuous with the lymph vessels outside passing through the wall of the ureter and opening into the lumen of the ureter (see illustrations 13 and 14).

The left kidney was not diseased, the glomeruli convoluted tubules and interstitial tissues were normal. The thoracic duct was carefully examined, and in its abdominal course was readily traced; its cavity had a diameter of 3 millimetres throughout the whole length, with the exception of one spot at which there was a double curve with a great narrowing of the lumen. At this point the diameter was only 0.5 of a millimetre, or one-sixth the usual diameter, and the walls were greatly thickened, as though some chronic inflammatory process had taken place. (See illustration 14a.)

No adults or embryos of *Filaria Bancroftii* were found during this investigation.

Illustration 11.* Photograph of the two kidneys and the interrenal mass.

* Not reproduced.

Illustration 12.* Microphotograph of section of a lymphatic gland in the interrenal mass. Magnified 80 times.

Illustrations 13 and 14.* Microphotograph of sections through the ureter and lymphatic mass showing dilated lymphatics passing through the wall of the ureter. Magnified 60 times.

LEPROSY.

In December, 1908, Professor Deycke began the nastin treatment of the lepers at the Government Leper Asylum, Mahaica. He continued this treatment till his departure in May, 1909, since when it has been carried on in accordance with his principles by the Medical Superintendent of that institution.

The treatment consists in the subcutaneous injection of a substance called nastin dissolved in weak benzoyl-chloride. These injections are performed once a week for three months, they are then omitted for three months, and recommenced for two months, and then occurs a non-injection period of three months, followed by a repeated injection period of three months.

The object of the treatment is the destruction of the lepra bacillus and thus the prevention of the progress of the disease and of the possibility of infection. As Professor Deycke writes: "Benzoyl nastin is an agent which directly acts on lepra bacilli."

At the Government Leper Asylum, Mahaica, about 116 persons are under this treatment. Of these 76 have been placed under special observation to ascertain to what extent the destruction of the bacilli occurs. These 76 cases comprise all those under nastin treatment showing leprotic nodules or infiltrations. Those cases purely anæsthetic (viz., the remaining 40 patients) were omitted since it is difficult to obtain from these the lepra bacillus for observation. The following tables show the age, sex, race, country of origin, and the approximate length of time the disease had been in progress in the patients observed.

TABLE I.

Age of Patients.

					Men.		Women.
1-10	...	...	...	...	0	...	1
11-20	...	...	...	...	28	...	11
21-30	...	...	...	...	11	...	12
31-40	...	...	...	...	7	...	2
41 and over	...	...	...	...	4	...	0
					—		—
					50		26
					—		—

TABLE II.

Sex of Patients.

Male	...	...	...	...	50
Female	...	...	...	...	26
					—
					76
					—

TABLE III.

Race of Patients.

					Men.		Women.
Black	...	...	...	...	34	...	18
Mixed	...	...	...	...	5	...	4
East Indian	...	...	...	...	6	...	3
Chinese	...	...	...	...	1	...	0
Portuguese	...	...	...	...	2	...	1
Other European races	...	...	...	...	2	...	0
					—		—
					50		26
					—		—

* Not reproduced.

TABLE IV.
Country of Origin of Patients.

	Men.	Women
British Guiana	44	24
Barbados	3	1
Surinam	1	0
India	2	1
	50	26

TABLE V.
Approximate length of time disease has existed.

	Men.	Women.
1 year and under	3	1
2-3 years	5	2
4-5 years	18	7
6-8 years	17	11
9-12 years	6	4
Over 12 years	1	1
	50	26

In observing the destruction of leprosy bacilli the appearances seen were divided up roughly into several classes as follows:—Slight or no destruction of bacilli, medium destruction of bacilli, and advanced destruction of bacilli.

After three months' period of injection the 50 men under observation (the 26 women were not under observation at this time) showed the following results:—

Slight or no destruction of bacilli	25
Medium destruction of bacilli	18
Advanced destruction of bacilli	7
	50

After three months' injection, two months' rest, and a further injection, the 76 patients showed results as follows:—

	Men.	Women.
1. Slight or no destruction of bacilli	9	11
2. Medium destruction of bacilli ...	9	1
3. Advanced destruction of bacilli ...	24	13
4. Extremely few bacilli found ...	2	0
5. Apparently all bacilli destroyed ...	3	1
6. Refused further treatment ...	1	0
7. Died	2	0
	50	26
Total—76		

This destruction of bacilli takes place as an ordinary bacteriolysis. Firstly, there appear colourless gaps, which remain unstained by Ziehl's or Gram's staining. (See illustrations 16 and 17.*)

These colourless gaps extend until the bacillus becomes reduced to nothing but a few stained dots. Subsequently the colourless areas begin to absorb the contrast stain used, and finally the whole bacillus becomes faintly stained by the contrast colour. As in no specimen are observed many bacilli thus stained with contrast colours, in spite of progressive and increasing bacteriolysis, it can only be concluded

* Not reproduced.

that the next stage is one of complete elimination, the more so as the contrast staining is rarely more than faint.

The effect of the nastin treatment on the patient shows itself in several ways.

The first way, and no doubt one of those more especially desired, is a gradual softening and retraction of the leprotic infiltration, leaving with the nodule a soft and flabby mass, with the infiltration *en cuirasse*, a wrinkled, flabby skin (see the hands and arms in illustration 20 and the hand in illustration 21). Sometimes more particularly in the face the skin appears to have followed the retraction of the leprotic infiltration and shows a fairly smooth surface, as though the primary elevation had been filed away (see the face in illustration 22).

The second way in which nastin acts on the patient is to produce ulceration in places where there was previously a nodule or some leprotic infiltration. This ulceration will continue for two to three weeks, and finally form a healed white scar now level with the skin. The infiltration has been ulcerated away and a scar left. There is nothing peculiar or specific to nastin about this ulceration; such ulceration occurs in leprosy patients naturally and without the application of nastin, but the injection of this substance appears to bring the ulceration on more extensively and to lead it on a shorter course and to a healthy scar formation. (Illustrations 21, 22, and 23 shows ulceration and scarring on wrist and hand. Illustration 25 shows ulceration on lips, ear, and hands.) The third way in which nastin appears to affect the patient is as a general specific reaction. High fever (temperature 103-104) begins with general malaise, after a few days' great pain is felt in some or all of the leprosy lesions, and a rapid breaking down of the leprotic formations ensues with or without ulceration. This reaction has occurred amongst the patients observed five times, and indicates probably too large a dose and should be avoided.

The fourth effect of nastin has reference to anæsthetic areas. These areas are considerably reduced with the earlier injections, and the patient's condition improved. Later the anæsthesia seems to progress until a final stationary condition is reached, from which no progression or retrogression takes place.

The fifth effect is a pigmentary effect on some of the nodular areas more especially in lighter-skinned people on the face and trunk. These areas develop sometimes a markedly darker colour than the surrounding skin, subsequently becoming quite light again.

ILLUSTRATIONS.*

Illustration 15—Microphotograph of lepra bacilli, showing no change; magnified 1,200 times.

Illustration 16—Microphotograph of lepra bacilli, showing early stages of destruction; magnified 1,200 times.

Illustration 17—Microphotograph of lepra bacilli, showing early stages of destruction and the resemblance to micrococci; magnified 750 times.

Illustration 18—Microphotograph of lepra bacilli, showing almost complete destruction; magnified 1,000 times.

Illustration 19—Microphotograph of lepra bacilli, showing almost complete destruction, only a few indistinct nodules being left; magnified 1,200 times.

Illustration 20—Photograph of patient No. 54, showing the wrinkling of the skin of the hands and arms.

Illustration 21—Photograph of the hand of patient No. 12, showing ulceration and scarring; also the wrinkling of the skin of the hand and wrist.

Illustration 22—Photograph of patient No. 8, to show the condition of the face; also the ulceration of the arms and hands.

Illustration 23—Photograph of the hand of patient No. 35, to show the ulceration.

Illustration 24—Photograph of the hand of patient No. 30, to show the ulceration and scarring.

Illustration 25—Photograph of patient No. 55, to show ulceration of lips, ears, arms, and hands.

K. S. WISE.

* Not reproduced.

No. 5.

CEYLON.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 23 August, 1909.)

MY LORD, The Queen's House, Colombo, Ceylon, 3rd August, 1909.

I HAVE the honour to forward herewith a report on the research work done in the Clinic for Tropical Diseases and Bacteriological Institute during the half-year ended 30th June, 1909, by Dr. Castellani, for transmission to the Advisory Committee for Tropical Diseases Research Fund.

I have, &c.,

HUGH CLIFFORD,
Officer Administering the Government.

Enclosure in No. 5.

REPORT on the Research Work done in the Clinic for Tropical Diseases and Bacteriological Institute during the six months ending 31 June, 1909, by ALDO CASTELLANI, M.D.

The amount of routine and administrative work at the Bacteriological Institute has increased to such an extent that absolutely no time is left for research work.

The little I have done during the last few years has been practically entirely carried out at the Clinic of Tropical Medicine outside my office hours.

The Clinic was founded by the Ceylon Government several years ago at the suggestion of Sir Allan Perry, Principal Civil Medical Officer, with the object of having a research hospital—with laboratory accommodation of its own—in which to investigate the ætiology, clinical features, and treatment of various tropical diseases.

The advantage of having an institution in which clinical and laboratory work is amalgamated is beyond doubt; the greatest workers in tropical medicine, such as Sir Patrick Manson and Laveran, having shown us that in the investigation of unknown or little known diseases, clinical and laboratory work must be fused together and not kept separate.

In the Clinic, which has been in my charge since it was opened in 1904, various investigations have been carried out, some of which have given results which are perhaps of some practical importance. I may mention the researches on the ætiology and treatment of yaws; the finding of a palliative treatment of elephantiasis; the description of several new tropical diseases: *pyosis tropica*, bronchial spirochætosis; low intermittent fever of Ceylon; high intermittent non-malarial fever of Ceylon; endemic funiculitis; *xantoderma areatum*; *keratoma plantare sulcatum*; *tinea intersecta*; *tin. aenigra*; *tinea alba*, &c., &c.

I would respectfully suggest that the Clinic, which now contains only 16 beds and a very small laboratory, should be enlarged as regards ward accommodation and laboratory rooms—in fact gradually developed into a complete Institute of Tropical Medicine. I might then be relieved of some of the routine work at the Bacteriological Institute in order to have more time to devote to investigation and research work in the Clinic. The Clinic might, in my humble opinion with advantage, depend administratively direct from the office of the Principal Civil Medical Officer instead of from a subordinate office, so that more sympathy would be shown and greater facilities given for research than is the case at present.

During the last six months I have made continued observations and researches on the following subjects:

1. Anti-typhoid vaccination with live vaccine.
2. Endemic funiculitis.
3. Intestinal bacteriological flora in the tropics.
4. Bronchial spirochætosis.
5. Parasitic ectoglobular bodies.

Anti-typhoid Vaccination with attenuated live cultures.

To Wright in England and to Kolle in Germany we owe the introduction of typhoid vaccines which have proved to be of practical importance. These vaccines consist of killed typhoid cultures—broth cultures as regards Wright's vaccine; emulsion of agar cultures as regards Kolle's vaccine. Leishmann has made the important observation that the lower the temperature at which the cultures are killed the more powerful is the vaccine.

It is well known that in the lower animals, such as rabbits, the use of dead cultures for immunising purposes is far less efficacious than using living cultures, provided the live cultures be inoculated with certain precautions. In man it has been proved, by Haffkine in cholera vaccination, by Strong and Kolle in plague vaccination, that the degree of immunisation obtained by using avirulent or attenuated live cultures is far greater than that obtained by using dead cultures: the same result was arrived at by me as regards typhoid.

Preparation of live typhoid vaccine.

I now prepare the vaccine in the following manner:—Tubes containing 10 c.c. of broth are each inoculated with two loopfuls of a 24 hours'-old agar culture of a typhoid strain which has been kept alive in the laboratory for the last three years and is now avirulent.* The broth tubes are kept in the incubator at 35° for 24 hours; they are then placed in a water bath at a constant temperature of 50 centigrades for one hour; after which the vaccine is ready for use. I always use it the same day I have prepared it. In this vaccine the typhoid bacilli are still alive, as is proved by inoculating agar tubes, in which they grow fairly well, though the growth may not be very rapid or abundant.

Effects of vaccination with live typhoid vaccine.

The objection to the use of live cultures for inoculation is that they may give rise to serious symptoms and may possibly transform the inoculated persons into typhoid carriers.

The typhoid vaccine prepared according to the method I have described is, however, in my experience, devoid of any serious risk. Before using it on a fairly extensive scale, I inoculated (four years ago) myself and fifteen of my Clinic and laboratory attendants and servants who volunteered for the experiment: it is to be noted that the vaccine was prepared by heating at 50 centigrades virulent cultures of typhoid, and not avirulent ones as I use at the present time. None of us experienced any severe symptom and none of us has become a typhoid carrier. In one case, after four days from the first inoculation, a fever developed which lasted five days; the microscopical examination of the blood proved it, however, to be of malarial origin.

The inoculation of the usual doses of live vaccine ($\frac{1}{2}$ c.c., 1 c.c., $1\frac{1}{2}$ c.c., is followed by the local and general reaction as is the case with dead vaccine (Wright vaccine); in some cases the reaction is somewhat more marked. After three or four hours the region of the arm where the inoculation has been made becomes painful and red, and fever supervenes, which generally does not last more than 24 hours and does not incapacitate one for work. In a certain number of cases (about 20 per cent.) the blood, after a few days, shows presence of agglutinins, whereas, personally, I have never seen any distinct production of agglutinins in man when using vaccines consisting of killed cultures. The Director of the Chemical Laboratory, Professor Browning, kindly submitted himself to repeated inoculations of the live vaccine; he received 1 c.c. of live vaccine regularly once a week for several weeks. The first inoculation caused a little local reaction and a slight degree of fever; the second inoculation induced a slighter local and general reaction; the third, fourth, fifth, and sixth inoculations were, practically, not followed by any reaction, either local or general. After the sixth and seventh the local reaction was very severe, and Professor Browning experienced a general malaise, though no fever was present. I stopped the inoculations for three weeks, after which he had another one, which did not give rise to any local or general reaction. The blood was regularly examined for agglutinins. These began to appear three days after the third inoculation (1 in 20 positive; 1 in 40 bacilli immobilized, but no clumps). It reached its

* Previously I used peptone-water cultures, as the inoculation of such cultures is somewhat less painful than broth cultures.

maximum four days after the fourth inoculation (agglutination limit 40). After the fifth inoculation the agglutination limit was only 20, and after the sixth and seventh hardly 10. It increased again to 20 after the eighth inoculation.

Experiments in animals.—In rabbits and monkeys the inoculation of a single dose of live vaccine (2 c.c.) induces the elaboration of a larger amount of agglutinins and immune bodies than the inoculation of the same dose of dead cultures. Very often a rabbit becomes highly immunized 8 to 15 days after receiving one single dose of live vaccine, while it may take several inoculations of dead vaccine to induce the same degree of immunity.

Comparative results in man.—These are collected in the following table:—

Method of Vaccination.	No. of Persons Inoculated.	Cases of Typhoid among the Inoculated.	Observations. (March, 1909.)
Both inoculations with dead vaccine (Wright).	106	2 (No death.)	40 were inoculated 18 months ago; 40—one year ago; and the remaining 26—three months ago.
Both inoculations with live vaccine.	90	None	14 were inoculated four years ago; 20—two years ago; 30—one year ago; and the remaining 26—three months ago.
First inoculation with dead vaccine (Wright). Second inoculation with live vaccine.	220	None	150 were inoculated 18 months ago; 45 one year ago; and the remaining 25—three months ago.

The results collected in this table tend to show that the inoculation of live vaccine gives a higher degree of immunity than the use of dead cultures. It must be noted that typhoid is extremely common in Ceylon.

Inoculation with mixed vaccines.

Several years ago (see Zeit. für Hygiene, 1903) while working in Bonn under the direction of Professor Kruse, I proved that by inoculating an animal with two different bacteria at the same time, the blood of the inoculated animals produced agglutinins and immune bodies for both, and that the amount of agglutinins and immune bodies for each germ was about the same as in those animals inoculated with one germ only. For example, inoculating a rabbit at the same time with *b. typhosus*, and *b. pseudodysentericus* (Kruse) the blood of the rabbit developed the same amount of agglutinins and immune bodies for the typhoid bacillus as control rabbits inoculated with typhoid only, and control animals inoculated with pseudodysentery only.

I demonstrated that, even inoculating a rabbit with three different micro-organisms (*b. typhosus* + *b. pseudodysentericus* (Kruse) + strain of *b. coli communis*), the amount of agglutinins and protective bodies elaborated for each germ was nearly the same as in animals respectively inoculated with one germ only. Moreover, I was able to confirm in the course of those experiments that when immunisation is obtained by a single inoculation—provided a certain minimum dose be given—the amount of agglutinins and immune bodies elaborated by the inoculated animals is not in proportion to the amount of cultures inoculated. A series of rabbits inoculated with 1 c.c. of typhoid culture will give the same average agglutination limit and immunization as a series of rabbits inoculated with 2 c.c.

Fredberger and Moreschi have demonstrated that, provided a certain minimum dose be given, the degree of immunization is the same as that obtained by a dose 400 times larger. These experiments tend to show that the standardization of vaccines by the count of the germs, as introduced by Wright, is not absolutely necessary, though certainly advisable whenever practicable.

I have tried mixed vaccines in man: typhoid-dysentery; typhoid-paratyphoid; typhoid-paratyphoid-dysentery. The vaccines are prepared by heating to 55 (dead vaccines) or 50 (live vaccines) for one hour broth cultures of *b. typhosus*, broth cultures of *b. dysenteriae* (Kruse-Shiga), broth cultures of *b. paratyphosus A* and *paratyphosus B*. These cultures are then mixed together in certain proportions in a sterile Petri dish, and the mixed vaccine is ready for use. The mixed typhoid-

paratyphoid vaccine consists of two parts of typhoid, one of paratyphoid A and one of paratyphoid B. The mixed typhoid-dysentery vaccine consists of one part typhoid and one part dysentery (Kruse-Shiga); but other mixed vaccines may be prepared and used: for instance, a mixed Kruse-Shiga and Flexner vaccine. Of these vaccines I generally inoculate $\frac{1}{2}$ c.c. of dead vaccine the first time, and after a week or fifteen days 1 c.c. or $1\frac{1}{2}$ c.c. of live vaccine.

The number of inoculations made is not sufficient to allow of a definite conclusion being arrived at, but it would seem that a contemporary mixed vaccination may give good results in man as it does in the lower animals.

Conclusions.

1. The use in man of the live typhoid vaccine prepared according to the method I have described (heating of non-virulent broth cultures at 50 Cent.) is not dangerous. It probably induces a higher degree of immunization than the ordinary vaccines consisting of dead cultures.

2. Though both inoculations may consist of live vaccine without danger, the routine method of anti-typhoid vaccination which I recommend and which I now use is the inoculation of $\frac{1}{2}$ c.c. usual dead vaccine (Wright) followed in a week's time by the inoculation of one cubic centimetre of live vaccine.

3. Mixed vaccines may be prepared by using dead or live attenuated cultures of typhoid and dysentery; or typhoid, paratyphoid, and dysentery. The inoculation of mixed vaccines may be of advantage in some cases, but the subject requires further investigation as regards its efficacy in man.

Intestinal Bacteriological Flora of normal individuals in the tropics.

The investigation has been carried out on healthy adult natives, Singhalese and Tamil, and two Europeans who had been for more than four months in the island. The diet of Tamils and Singhalese of the lower classes—to which the natives examined belonged—consists mostly of vegetables (rice, plantains, jack-fruit, pumpkin, beans, brinjal) with occasionally fish, and, very rarely, owing to religious principles, mutton or beef. The diet of Europeans and better class natives is the usual vegetarian-meat diet.

Technique.—The stools were collected in large sterile Petri dishes and plated almost immediately, using ordinary agar and also Mackonkey neutral red bile salt. The plates were incubated at 35-77 centigrades for 48 hours, after which a certain number of colonies (9 or 10 for each individual) taken at random were further investigated, using various sugar media, &c. The investigation has been limited practically to aerobic germs of the fami bacteriaceæ.

The details of the investigation are collected in the following 11 tables.

TABLE I.

Nines Singhalese Boy. Age 18 years. Diet :—Rice, Vegetables, Fish, Mutton. Stool Plated on Neutral Red, Laet., Bi., Salt Agar, 16 February, 1909. (9 colonies taken for investigation).

No	Maltose.	Glucose.	Lactose.	Mannite.	Dulcite.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
1	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	Non-liquefied, 23 days.	Coli-like growth, more delicate.	Non-liquefied.	G.T.	G.T.	O.	O.	O.
2	A.G.	A.G.	D.G.	A.G.	A.G.	O.	O.	G.	Liquefied, 18 days.	"	Liquefied, 18 days.	G.T.P.	"	O.	O.	O.
3	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	D.C.	G.	Non-liquefied, 23 days.	"	Non-liquefied.	G.T.	"	O.	O.	O.
4	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	"	"	O.	O.	O.
5	A.G.	A.G.	D.G.	A.G.	A.G.	O.	D.	G.	"	"	"	"	"	O.	O.	O.
6	A.G.	A.G.	A.G.	A.G.	A.G.	O.	D.C.	G.	"	"	"	"	"	O.	O.	O.
7	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.P.	"	O.	O.	O.
8	A.G.	A.G.	D.G.	A.G.	A.G.	O.	O.	G.	"	"	"	"	"	O.	O.	O.
9	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	"	"	"	"	"	O.	O.	O.

Abbreviations used in the Tables :—

A. = Acid. G. = Gas. C. = Clot. D. = Decolourised. G.T. = General Turbidity. P. = Pellicle. O. = Negative Result viz. : Neither Acid nor Gas in Sugar Media, Acid nor Clot in Milk, Non-motile or Non-production of Indole as the case may be. + = Positive Result. (Production of Indole or Motility of Bacillus as the case may be.)

TABLE II.

Tamil Coolie. Age, 30 years. Diet :—Rice and Vegetables. Stool plated on N. R. L. B. S. Agar. 2nd March 1903.
10 Colonies taken for investigation.

No.	Maltose.	Glucose.	Lactose.	Mannite.	Dulcite.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
1	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	Non-liquefied, 26 days.	Thin whitish growth.	Non-liquefied.	G.T.	G.T.	+F.	O.	O.
2	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	D.C.	G.	"	"	"	G.T.	G.T.	+F.	O.	O.
3	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	+F.	O.	O.
4	A.G.	A.G.	A.G.	A.G.	A.G.	D.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
5	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
6	A.G.	A.G.	A.G.	A.G.	A.G.	D.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
7	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
8	A.G.	A.G.	A.G.	A.G.	A.G.	D.G.*	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
9	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	D.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
10	A.G.	A.G.	A.G.	A.G.	A.G.	D.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.

* = Tiny bubble. F = Feeble.

TABLE III.

Vallen. Tamil Coolie. Age, 45 years. Diet :—Rice and Curry. Stool plated on N. R. L. B. S. Agar. 15th March, 1909.
10 Colonies taken for investigation.

No.	Maltose.	Glucose.	Lactose.	Mannite.	Dulcite.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
1	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	D.C.	G.	Non-liquefied.	Thin semi-transp. growth.	Non-liquefied.	G.T.Sl.P.	G.T.	+	O.	O.
2	A.G.	A.G.	O.	A.G.	A.G.	O.	O.	G.	"	Whitish coli-like.	"	G.T.P.	G.T.	++	O.	+
3	A.G.	A.G.	A.G.	A.G.	A.G.	D.G.	A.C.	G.	"	Thin semi-transp.	"	G.T.Sl.P.	G.T.	++	O.	O.
4	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	D.C.	G.	"	"	"	G.T.Sl.P.	G.T.	+F.	O.	+
5	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	D.C.	G.	"	"	"	G.T.Sl.P.	G.T.	+F.	O.	++
6	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	D.C.	G.	"	"	"	G.T.	G.T.	+F.	O.	O.
7	A.G.	A.G.	A.G.	A.G.	A.G.	D.G.	A.C.	G.	"	"	"	G.T.	G.T.	+F.	O.	+
8	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	D.C.	G.	"	"	"	G.T.Sl.P.	G.T.	+F.	O.	++
9	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.Sl.P.	G.T.	+F.	O.	++
10	A.G.	A.G.	D.G.	D.G.	D.G.	D.G.	A.C.	G.	"	"	"	G.T.P.	G.T.	+	O.	O.

Sl.P. = Slight Pellicle. F. = Feeble. ++ = Very Marked.

TABLE IV.

European Resident in Colombo, seven months. Age 30 years. Diet :—General. Stool plated on N. R. L. B. S. Agar. 29th March, 1909. 9 Colonies taken for investigation.

No.	Maltose.	Glucose.	Lactose.	Mannite.	Dulcite.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
8	A.G.	A.G.	A.G.	A.G.	D.G.	D.Sl.G.	A.	G.	Non-liquefied.	Thin coli-like.	Non-liquefied.	G.T.P.	G.T.	++	O.	+
5	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	"	"	"	G.T.	G.T.	+F.	O.	O.
9	A.G.	A.G.	A.G.	A.G.	A.G.	D.Sl.G.	A.	G.	"	"	"	G.T.Sl.P.	G.T.	+	O.	++
10	A.G.	A.G.	A.G.	A.G.	A.G.	D.Sl.G.	A.C.	G.	"	"	"	G.T.Sl.P.	G.T.	+	O.	++
B	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	"	"	"	G.T.P.	G.T.	+	O.	+
1	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	"	"	"	G.T.P.	G.T.	+	O.	O.
6	A.G.	A.G.	A.G.	A.G.	A.G.	D.Sl.G.	A.C.	G.	"	Thicker growth.	"	G.T.P.	G.T.	+	O.	++
7	A.G.	A.G.	A.G.	A.G.	A.G.	D.Sl.G.	A.C.	G.	"	"	"	G.T.P.	G.T.	+	O.	+
3	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.

Sl.G. = Slight Gas.

TABLE V.

Kadiravelu. Tamil Coolie. Attendant at Clinic. Age 45 years. Diet :—Rice and Curry, Vegetables. Stool plated on N. R. L. B. S. Agar. 16th April, 1909. 10 Colonies taken for investigation.

No.	Maltose.	Glucose.	Lactose.	Mannite.	Dulcitol.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
1	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	Non-liquefied.	Thin whitish (waxy).	Non-liquefied.	G.T.P.	G.T.	+F.	O.	+F.
2	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.P.	G.T.	+F.	O.	+F.
3	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.P.	G.T.	+F.	O.	+F.
4	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.P.	G.T.	+F.	O.	+F.
5	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.P.	G.T.	+F.	O.	+F.
6	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.P.	G.T.	+F.	O.	+F.
7	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.P.	G.T.	+F.	O.	+F.
11	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.P.	G.T.	+F.	O.	+F.
14	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.	G.	"	Thin whitish (dry).	"	G.T.Sl.P.	G.T.	+	O.	O.
9	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.	G.	"	"	"	G.T.Sl.P.	G.T.	+	O.	O.

TABLE VI.

Muttama. Tamil Estate Coolie. Age 14 years. Diet :—Rice, Curry, Vegetables. Stool plated on N. R. L. B. S. Agar. 7th May, 1909. 12 Colonies taken for investigation.

No.	Maltose.	Glucose.	Lactose.	Mannite.	Dulcitol.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
1	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.*	G.	Non-liquefied.	Thick whitish growth. Coli-like.	Non-liquefied.	G.T.P.T.	G.T.P.	+	O.	+F.
2	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	"	"	"	G.T.Sl.P.†	G.T.	+	O.	+
3	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	"	"	"	"	G.T.	+	O.	+
4	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	"	"	"	"	G.T.	+	O.	+F.
5	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.*	G.	"	Thick whitish growth.	"	G.T.P.T.	G.T.P.	+	O.	+F.
6	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	Liquefied, 23 days.	"	Sl. liquefied, 23 days.	G.T.	G.T.	+F.	O.	++
7	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.	G.	"	"	"	G.T.	G.T.	O.	O.	+
8	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.*	G.	Non-liquefied.	"	Non-liquefied.	G.T.P.T.	G.T.P.	+	O.	+F.
9	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.*	G.	"	"	"	"	G.T.P.	+	O.	+F.
10	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.†	G.	Sl. liquefied, 23 days.	"	Sl. liquefied, 23 days.	G.T.	G.T.	O.	O.	+
11	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.	G.	Non-liquefied.	"	Non-liquefied.	G.T.Sl.P.	G.T.	+	O.	+
12	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	Liquefied, 23 days.	"	Sl. liquefied.	G.T.	G.T.	O.	O.	+

* = Decolorised after 48 hours quite white.

† = Only very slightly acid.

‡ = Very slight pellicle after five days.

T. = Thick pellicle.

TABLE VII.

Wellan. Tamil Coolie. Age, 30 years. Diet :—Fish, Rice, Vegetables. Stool plated on N. R. L. B. S. Agar.
29th May, 1909. 10 Colonies taken for investigation.

No.	Maltose.	Glucose.	Lactose.	Mannite.	Dulcite.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
1	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	Non-liquefied.	Whitish coli-like.	Non-liquefied.	G.T.Sl.P.	G.T.	+F.	O.	+
2	A.G.	A.G.	A.G.	A.G.	O.	D.G.	D.C.*	G.	Very slowly liquefied.	"	"	G.T.P.	G.T.	+F.	O.	+
3	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	Non-liquefied.	"	"	G.T.	G.T.	+F.	O.	+F.
4	A.G.	A.G.	A.G.	A.G.	O.	A.†	A.	G.	"	"	"	G.T.	G.T.	+F.	O.	+
5	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	+
8	A.	A.	A.	O.	O.	A.	A.C.*	O.	"	Very thin growth.	Growth?	Clear	Clear	+F.	+	O.
9	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	"	Whitish coli-like.	Non-liquefied.	G.T.	G.T.	+	O.	+
10	A.G.	A.G.	A.G.	A.G.	O.	D.G.	A.C.	G.	"	Whitish growth.	"	G.T.Sl.P.	G.T.	+F.	O.	O.
11	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	"	G.T.	+	O.	+
12	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	Slowly liquefied, 38 days.	Thick white growth.	Slowly liquefied.	G.T.P.	G.T.	+F.	O.	++

No. 8.—A Streptococcus.

* = Clot after 13 days. † = Acid after 7 days.

TABLE VIII.

Mariamamma. Tamil, female attendant at Clinic. Age, 35 years. Diet :—Rice, Fish, Curry, Vegetables, Meat.
Stool plated on N. R. L. B. S. Agar. 29th May, 1909. 10 Colonies taken for investigation.

No	Maltose.	Glucose.	Lactose.	Mannite.	Dulcite.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
1	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	Non-liquefied.	Whitish coli-like.	Non-liquefied.	G.T.Sl.P.	G.T.	+	O.	O.
2	A.G.	A.G.	A.G.	A.G.	O.	O.	A.S.*	G.	"	"	"	G.T.Sl.P.	G.T.	+	O.	O.
3	A.G.	A.G.	A.G.	A.G.	O.	O.	A.S.*	G.	"	"	"	G.T.Sl.P.	G.T.	+	O.	O.
4	A.G.	A.G.	A.G.	A.G.	O.	O.	A.S.*	G.	"	"	"	G.T.Sl.P.	G.T.	+	O.	O.
5	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.S.*	G.	"	"	"	G.T.	G.T.	+	O.	O.
6	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
7	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
9	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.C.	G.	Very slowly liquefied.	"	Very slowly liquefied.	G.T.Sl.P.	G.T.	+F.	O.	+
10	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.C.	G.	"	"	"	G.T.Sl.P.	G.T.	+	O.	+
11	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.C.	G.	Non-liquefied.	Thick white moist.	Non-liquefied.	G.T.Sl.P.	G.T.	+	O.	O.

* = Complete separation. Practically all clear whey.

TABLE IX.

Arumogam, Tamil Coolie. Age 36 years. Diet :—Vegetables, Fish, Rice and Curry. Stool plated on N. R. L. B. S. Agar. 31st May, 1909. 10 Colonies taken for investigation.

No.	Maltose.	Glucose.	Lactose.	Mannite.	Dulcite.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
1	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	Non-liquefied.	Whitish coli-like.	Non-liquefied.	G.T.	G.T.	+	O.	O.
2	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
3	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
4	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	Whitish (rather thick).	"	G.T.	G.T.	+	O.	O.
5	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	Whitish coli-like.	"	G.T.	G.T.	+	O.	O.
6	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
7	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
8	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	++	O.	O.
9	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	Whitish coli-like (thick).	"	G.T.	G.T.	+	O.	O.
10	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.

TABLE X.

Singho Appu, Sinhalese. Age 45 years. Cook at Clinic. Diet :—Rice, Curry, Vegetables, Meat. Stool plated on N. R. L. B. S. Agar. 31st May, 1909. 12 Colonies taken for investigation.

No.	Maltose.	Glucose.	Lactose.	Mannite.	Dulcite.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
1	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.C.	G.	Very slow liquefied.	Thin whitish growth.	Non-liquefied.	G.T.	G.T.	+ F.	O.	+
2	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	Non-liquefied.	"	"	G.T.P.	G.T.P.	+	O.	O.
3	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	"	"	"	G.T.P.	G.T.P.	+	O.	+
4	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
5	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	"	"	"	G.T.P.	G.T.P.	+	O.	O.
6	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	"	Whitish (rather dry). Thin whitish.	"	G.T.P.	G.T.P.	+	O.	O.
7	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
8	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	+	O.	O.
9	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.C.	G.	"	"	"	G.T.	G.T.	O.	O.	O.
10	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	"	"	"	G.T.P.	G.T.P.	+	O.	+ F.
11	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	"	"	"	G.T.P.	G.T.P.	+	O.	+ F.
12	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	"	"	"	G.T.P.	G.T.P.	+	O.	+ F.

TABLE XI.

European. Resident in Colombo four months. Diet :—General. Stool plated on N. R. L. B. S. Agar. 22nd June, 1909. 12 Colonies taken for investigation.

No.	Maltose.	Glucose.	Lactose.	Mannite.	Dulcite.	Saccharose.	Litmus Milk.	Glucose Agar.	Gelatine.	Agar.	Serum.	Broth.	Peptone Water.	Indole.	Gram.	Motility.
1	A.G.	A.G.	A.G.	A.G.	D.G.	A.G.	A.C.	G.	Non-liquefied.	Whitish, moist.	Non-liquefied.	G.T.P.*	G.T.	+	O.	O.
2	A.G.	A.G.	A.G.	A.G.	D.G.	D.G.	A.C.	G.	"	"	"	G.T.P.*	G.T.	+	O.	+
3	A.G.	A.G.	A.G.	A.G.	D.G.	D.G.	A.C.	G.	"	"	"	G.T.P.*	G.T.	+	O.	+
4	A.	A.G.†	O.	O.	O.	A.	O.	O.	"	Rather thin, white.	"	G.T.P.T.	G.T.	+	O.	O.
5	A.G.	A.G.	A.G.	A.G.	D.G.	D.G.	A.C.	G.	"	Whitish, moist.	"	G.T.P.*	G.T.	+	O.	+
6	A.G.	A.G.	A.G.	A.G.	D.G.	D.G.	A.C.	G.	"	"	"	G.T.P.*	G.T.	+	O.	O.
7	A.G.	A.G.	A.G.	A.G.	D.G.	D.G.	A.C.	G.	"	"	"	G.T.P.*	G.T.	+	O.	O.
8	A.G.	A.G.	A.G.	A.G.	D.G.	D.G.	A.C.	G.	"	"	"	G.T.P.*	G.T.	+	O.	O.
9	A.G.	A.G.	A.G.	A.G.	D.G.	D.G.	A.C.	G.	"	"	"	G.T.P.*	G.T.	+	O.	O.
10	A.G.	A.G.	A.G.	A.G.	D.G.	D.G.	A.C.	G.	"	"	"	G.T.P.*	G.T.	+	O.	O.
11	A.G.	A.G.	A.G.	A.G.	D.G.	D.G.	A.C.	G.	"	"	"	G.T.P.*	G.T.	+	O.	+
12	A.G.	A.G.	A.G.	A.G.	D.G.	D.G.	A.C.	G.	"	"	"	G.T.P.*	G.T.	+	O.	+

* = Pellicle formed after 5 days.

† = Tiny Bubble Gas, 9 days.

From the preceding tables it will be seen that the total number of colonies completely investigated was 114. This is not a large number, but the time and labour involved in studying completely a single colony is such that the investigation could not be larger.

The classification of intestinal bacteria is difficult owing to the various descriptions given of coli and coli-like bacilli: I follow Mackonkey in his definition of *b. coli communis* (Esherish *b. napolitanus*; *b. acidi lactici*; *b. lactis derogenes*; *b. cloacæ*). In addition to the germs belonging to these groups, micro-organisms were found belonging to various other groups.

The results of the whole investigation may be seen in the following table:—

TABLE XII.

Intestinal Bacteria Isolated.	No. identified out of 114 Colonies Investigated.	Cultural Characters.													
		Maltose.	Glucose.	Lactose.	Mannite.	Dulcite.	Saccharose.	Litmus Milk.	Glucose Agar.	Liquefaction of Gelatine.	Liquefaction of Serum.	Motility.	Indole.	Gram.	Voges-Proskauer's Reaction.
1. <i>B. acidi lactici</i> (Hüppe).	9	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	O.	O.	O.	+	O.	O.
2. <i>B. grüntali</i> (Castellani).	6	A.G.	A.G.	A.G.	A.G.	O.	O.	A.C.	G.	O.	O.	+	+	O.	O.
3. <i>B. lctis aerogenes</i> (Escherich).	4	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.C.	G.	O.	O.	O.	±	O.	+
4. <i>B. coli communis</i> (Escherich).	6	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	O.	O.	+	+	O.	O.
5. <i>B. coli immobilis</i> (Durham).	7	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.C.	G.	O.	O.	O.	±	O.	O.
6. <i>B. neapolitanus</i> (Emmerich).	36	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	O.	O.	O.	±†	O.	O.
7. <i>B. pseudo-coli</i> (Castellani).	22	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	O.	O.	+	+	O.	O.
8. <i>B. cloacae</i> (Jordan).	4	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.C.	G.	+	±	+	±	O.	+
9. <i>B. tropicalis</i> (Castellani).	3	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	G.	O.	O.	O.	O.	O.	O.
10. <i>B. para tropicalis</i> (Castellani).	7	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.	G.	O.	O.	+	+	O.	O.
11. <i>B. enteritidis</i> (Gaertner).	1	A.G.	A.G.	O.	A.G.	A.G.	O.	O.	G.	O.	O.	+	+	O.	O.
12. Undetermined ...	1	A.G.	A.G.	A.G.	A.G.	O.	A.*	A.	G.	O.	O.	+	+	O.	O.
" ...	1	A.	A.G.‡	O.	O.	O.	A.	O.	O.	O.	O.	O.	+	O.	O.
" ...	1	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	+	+	O.	O.	O.	O.
" ...	3	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.C.	G.	++	++	+	+	O.	O.
" ...	2	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.	G.	++	++	+	+	O.	O.
Streptococcus ...	1	A.	A.	A.	O.	O.	A.	A.C.	O.	O.	O.	O.	+	+	O.

* = Acid after 7 days. † = Liquefaction started 23 days. ‡ = Only 2 out of 36 gave indole O.
§ = Tiny bubble gas after 9 days. A. = Acid. C. = Clot. G. = Gas.
+ Indicates production of indole, or motility of bacillus, or liquefaction of gelatine or serum, as the case may be.
O. = Negative result, viz. :—Neither acid nor clot in milk, neither acid nor gas in sugar media, non-production of indole, non-motile, or non-liquefaction of gelatine or serum, as the case may be.

Conclusion.

In 11 normal individuals—nine of whom were natives—living in Ceylon, the typical *b. coli communis* (Esherish) was found to be extremely rare. The majority of the germs were represented by *b. napolitanus*, *b. pseudocolon*, *b. acidi lactici*, and *b. paratropicalis*.

I wish to express my indebtedness to Mr. E. Burgess for his continuous assistance given during this investigation.

Bronchial Spirochaetosis.

In 1904 and 1905 I observed in Ceylon two cases of a peculiar form of bronchitis characterized by the presence in the expectoration of enormous numbers of spirochaetes. I described the condition in a paper which I published in the "Lancet" (May 19, 1906). Later I observed several other cases. Recently (see Trans. Soc. Tr. Med. 1909) Waters has described numerous cases of bronchial spirochaetosis in India, dwelling especially on the acute type of the disease. Cases have been observed in the Philippine Islands by Jackson and others.

Two types of the disease, in my experience, may be observed; acute broncho-spirochætosis and chronic broncho-spirochætosis. In the acute type the patient has fever, feels weak, and coughs much, the expectoration being scanty and of a mucous character, but very often the general condition—according to my experience—is not bad. Chronic bronchial spirochætosis may follow on an acute attack, but very frequently—at least in Ceylon—the onset is quite insidious and slow. The patient has a chronic cough, which is frequently more severe in the mornings; expectoration is not very abundant and is muco-purulent in character; it is non-nummular. In many cases, now and then, for periods of two or three days and even much longer, the expectoration contains blood, intimately mixed with the muco-pus and varying in amount; sometimes attacks of genuine hæmoptysis occur, one or two teaspoonsful or even more of blood being expectorated. In some cases there is no fever; in others a true ectic-like fever may be present; in some cases, however, the rise of temperature takes place in the morning and not in the afternoon; in others the fever is present only occasionally and is very irregular. The physical examination of the chest reveals very little except a few dry or coarse moist rales. The general condition may remain fairly good for a long time, though a certain degree of anæmia is always present. A few cases waste rapidly.

Course, prognosis, treatment.

The course of the disease is very long: the first case I observed in 1904 is alive and his condition is very much better. The treatment with the ordinary expectorant mixtures is unsatisfactory; in chronic cases glycerophosphates and arsenic give somewhat better results.

Diagnosis.

The acute type is generally mistaken for influenza or malaria. The examination of the sputum, in which no Pfeiffer's bacilli are found, will distinguish the affection from influenza—and the examination of the blood will exclude malaria.

Cases of the chronic type, so common in Ceylon, presenting blood in the expectoration, are generally diagnosed as phthisis. The examination of the sputum for tubercular bacilli will be always negative and the animal inoculation will remain without effect: the opthalgo and cuti-reactions are negative in the great majority of cases. Occasionally, however, cases of mixed infection—tuberculosis and spirochætosis—occur; one such case has been described by Branch.

Spirochætosis is easily distinguished from endemic hæmoptysis by the examination of the sputum, which will show absence of ova of *distomum ringeri*.

Ætiology.

In the expectoration enormous numbers of spirochætes are found. In my article published in 1906 in the "Lancet," I distinguished several types in preparations stained by Leishmann. My more recent investigations confirm these results. Four principal types of spirochætes may be distinguished:—

1. Very thick individuals from 15 to 30 microns in length, with irregular coils which vary in number but are never numerous—they generally stain bluish.

2. Spirochæte resembling the *s. refringens* (Shaudinn) with a few graceful waves and pointed extremities.

3. Thin delicate spirochæte with fairly numerous small uniform coils and tapering ends. Sometimes one of the extremities is blunt while the other is pointed. This is perhaps the commonest type.

4. Extremely thin and delicate organisms with very few irregular shaped coils. There is little doubt, therefore, that under the name *s. bronchialis* (Cast. 1907) there are several species, or at least varieties.

Whether the spirochætes found in the expectoration are the real cause of the condition cannot yet be said, but it seems to me not improbable that the spirochætes present in such large numbers sometimes with practically no other germ present may play an important ætiological rôle.

Ætiology and Pathology of "Endemic Funiculitis."

A peculiar suppurative condition of the spermatic cord has been known for many years to the Ceylon practitioners, who indicated the condition under the name of "corditis" or "flebitis of the cord." The condition was by some considered to be of filarial origin; by others to be of venereal origin. Some practitioners con-

sidered the disease to be a malarial affection. The malady was investigated by me in 1904, and more completely, at the request of Dr. C. Paul, in 1907. I came to the conclusion that the disease had sufficiently characteristic symptoms to be considered a separate disease, for which I proposed the name of *endemic funiculitis*. Madden described the same malady under the name of cellulitis of the spermatic cord. A very important publication on the subject is the recent one by Coutts. For the description of the malady I refer the reader to Madden, Coutts, and my own publications, but a few words on the clinical aspect of the condition may not be out of place here.

The onset is generally abrupt: the patient complains suddenly of severe pain along the cord and the epididymis; as a rule there is fever and the general condition becomes rapidly worse. At the physical examination it will be seen that the inguinal region is occupied by a large cylindrical swelling in the direction of the cord, very painful on pressure. The skin is not affected. In most cases the epididymis is somewhat enlarged and tender, while the testicle proper appears to be normal. On examination of the penis and scrotum no ulcers are found, no signs of gonorrhœa. There is no tendency to spontaneous cure. If an operation is not performed in time a general septicæmia develops; the skin of the patient becomes jaundiced, cutaneous hæmorrhages appear, the fever is of an intermittent or remittent type, and the patient dies in a few days. Very occasionally mild cases may be met with which recovered spontaneously. A chronic type, to which special attention has been called by Coutts, also exists.

Pathology—Aetiology.

The whole of the spermatic cord is highly inflamed and infiltrated—circumference of the cord may be as much as $3\frac{1}{2}$ inches. On making a transverse section yellow, creamy pus will exude from the opened veins of the pampamiform plexus as well as, often, from the vas deferens. The inflammation frequently extends to the epididymis, while the testicle proper is normal. Some clear fluid may be present, however, in the tunica vaginalis. At the post-mortem of those cases in which an operation has not been performed in time, the lesions found are those of other septicæmic processes. The skin is jaundiced and may present petechiæ, the lungs often show hypostatic congestion; the heart is flabby and subpericardial hæmorrhages are often seen. The spleen is enlarged and soft; the liver is generally enlarged and may show fatty degeneration or cloudy swelling. The kidneys are often congested.

Histo-pathology.

The microscopical study of the sections of the cord will show the veins of the pampamiform plexus dilated and occupied by pus cells or by thrombi: a cellular infiltration of all the coats as well as a perivascular infiltration is present. According to Coutts's and my own researches the type of infiltration is mostly mononuclear. The vas deferens also is in many cases occupied by pus—or may be occupied by a cellular granulation tissue: its muscular membranes and various muscular coats show a diffuse cellular infiltration.

Aetiology and Pathogenesis.

My recent researches confirm the result of my first investigation. In 98 per cent. of my cases a streptococcus was present in the pus of the veins of the pampamiform plexus: in two post-mortems the same germ was found in the blood of the heart, and during life it has occasionally been isolated from the blood of the general circulation in septicæmic cases. I have isolated various strains of this streptococcus—they all agree in one character, viz., they are decolorized by Gram's in sections of the tissues and in smears from the pus, while preparations made from cultures decolorize incompletely, and some cultures may even be gram-positive. Other germs (strains of monyngococcus) may present, as well known, this same peculiarity, viz., of being gram-negative in preparations from the tissues, and gram-positive in preparations from cultures. In smears made from the pus and stained with methylene-blue the cocci are often arranged in pairs and may show a gono-

coccus-like appearance. The principal characters in culture media are as follows :—

Agar.—The growth is very delicate but some strains may grow fairly abundantly, the colonies coalescing together.

Gelatine.—Same characters as in agar, only more delicate. A few strains do not grow on gelatine.

Broth.—In some cases general turbidity, in others the medium remains clear, while some sediment may be present.

Peptone-water.—Very scanty or no growth at all.

Milk.—The milk is rendered acid and occasionally clotted.

MacKonkey's agar.—No growth.

Serum media.—Nothing characteristic.

Sugar media.—The reactions vary, most of the strains I have isolated lately give the following reactions :—

Glucose broth—acid.

Lactose broth—acid.

Maltose broth—acid.

Saccharose broth—acid.

Saccharine broth—no change.

Mannite—no change.

Dulcite—no change.

The germ I have described, therefore, cannot be distinguished from the usual strains of *s. pyogenes*, except, perhaps, by its being Gram-negative in preparations made from the pus or in sections. Does this germ play any rôle in the ætiology of the disease? I am now inclined to give it more importance than I was at first willing to do. The constant presence of the germ is very suggestive. If this germ plays an ætiological rôle, which is the pathogenesis of the malady? Coutts states that the micro-organism is often found in the urethra of natives, and he regards the suppurative condition of the cord as due to the extension of an infectious process from the urethra by way of the vas deferens. To a certain extent I can confirm Coutts's opinion, having found the organism in the urethra of two patients suffering from endemic funiculitis and presenting an extremely mild catarrhal inflammation of the urethra of non-gonorrheal origin. I have, however, not found it in six other cases examined.

A certain importance as predisposing causes must be given to a sudden chill and perhaps some slight traumatism. In almost all my cases the disease began abruptly after the patient had taken a cold bath while feeling tired, though not unwell. A few of my patients gave a history of having made an effort in lifting a weight, such as a big stone, &c.

Conclusions.

1. The ætiology of endemic funiculitis requires further investigation, but it is probable that the micro-organism described by me, and the presence of which in the disease has been confirmed by Coutts, may play an important ætiological rôle, at least in the suppurative stage of the malady.

2. The micro-organism is a streptococcus practically undistinguishable from the usual strains of *streptococcus pyogenes*, except by its being—at least in my cases—Gram-negative in preparations made from pus and in sections of tissues.

3. As regards the pathogenesis of the disease, Coutts's opinion that the malady develops through an extension of a mild or latent urethral infective process, *viâ* the vas deferens, has many points in its favour.

4. A sudden chill—such as taking a cold bath—and any kind of sudden traumatism, are probably important predisposing causes.

Peculiar Ectoglobular Parasitic Bodies found in the Blood of Man and some of the Lower Animals.

In 1905, Dr. Willey and myself, while investigating the haematozoa of Ceylon, observed some peculiar crescentic bodies in the blood of two native convicts. We described these bodies in the "Journal of Microscopical Science" under the name of free gregariniform bodies. Similar bodies were found later in Indian bulls by myself, and other bodies, probably related, were found by Sambon in apes. The

brothers Sergeant have recently described ectoglobular bodies in a native patient of Algeria. It may be of interest to compare briefly these various bodies.

Bodies described by Dr. Willey and myself in man (1905).—These bodies are generally a crescentic shape. They are 10 to 20 microns in length and 2 to 5 in breadth. They often present vacuoles. A nucleus is seen in some specimens; in many others no nucleus can be seen. The whole body stains bluish, while here and there granules of chromatin are present. They cannot be compared with malaria crescents as they never contain pigment. In another case we found different shaped bodies, somewhat dumbbell-like, but these we were inclined to consider to be fungi deposited on the slides, though every precaution was taken to have clean slides.

Bodies found in man by the brothers Sergeant.—These bodies were observed in 1908 by the brothers Sergeant in a patient in Algeria suffering from night sweats and nausea. They have a crescentic shape and pointed extremities; average length, 40 microns; maximum breadth $1\frac{1}{2}$ microns. These bodies are, I think, related to those found by Willey and myself.

Bodies found in Indian bulls.—These were observed by me in two Indian bulls in 1906, when I considered them to be closely related to those found in man, although larger. Quite recently, Mr. Sturges and myself have come across another bull harbouring these bodies. Only films were made, as the owner of the bull lives at some distance from the laboratory. In preparations stained with Gienisa the bodies have a bluish tint with often specks of chromatin dotted here and there all over the body. The shape is that of a crescent with extremities which are often obtuse but may be quite pointed. Very rarely the parasite may have a fusiform shape instead of a crescentic one. The protoplasm may present a vacuolated appearance. In most individuals a central nucleus may be seen. The nucleus is rather large, containing apparently very little chromatin.

Bodies discovered by Dr. Sambon.—These bodies were observed by Dr. Sambon in an ape. When I was in England he very kindly showed me several films, and, in my opinion, these bodies have in all probability some relation to the bodies described above. I refrain from giving details, as Dr. Sambon has not yet published his observations on the subject. His publication will be awaited with great interest.

Remarks.—Peculiar ectoglobular bodies have been described by Willey and the brothers Sergeant in man, and in the lower mammalia by Sambon and myself. These bodies are probably all protozoa and closely allied, though of different species. In my opinion they are not hæmogregarins, and will have to be collected in a genus of their own. Much further investigation is, however, necessary before coming to any definite conclusion.

ALDO CASTELLANI.

Colombo,
Ceylon.

No. 6.

EAST AFRICA PROTECTORATE.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 6 March, 1909.)

MY LORD, Governor's Office, Nairobi, 8 February, 1909.

I HAVE the honour to submit copy of a report by the Principal Medical Officer submitting the report of the Bacteriological Department for the half year ending the 31st December last.

2. I would particularly invite attention to the experiments made with *Glossina fusca* and *Glossina longipennis* to which allusion is made in paragraphs 2 and 3 of Dr. Milne's Report.

I have, &c.,
J. HAYES SADLER.

Enclosure in No. 6.

SIR, Principal Medical Officer's Office, Nairobi, 30 January, 1909.

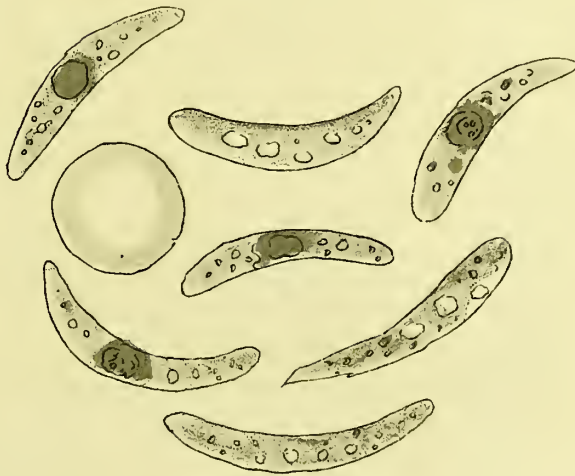
I HAVE the honour to forward, in triplicate, the Acting Bacteriologist's half-yearly report on the work done in the laboratory for the six months ending December 31st, 1908. Dr. Ross, the Bacteriologist, proceeded home on leave of absence on

PECULIAR ECTOGLOBULAR PARASITIC BODIES.

BODIES FOUND IN MAN BY
DR WILLEY AND MYSELF.



BODIES FOUND IN INDIAN
BULLS BY MYSELF.



BODIES FOUND IN MAN BY
THE BROTHERS SERGEANT



November 19th, and it has accordingly fallen to his successor in office, Dr. Small, to complete his report on the work done since that date to the end of the year.

2. Original research has been a continuation of the experiments detailed in the half-yearly report immediately preceding. The main point of these experiments was to determine how long the species of tsetse fly known as *Glossina fusca* after becoming infected could retain its power of transmitting animal trypanosomes to clean, uninfected animals. The experiments were conducted by feeding freshly caught flies first on infected animals, and then transferring them at varying intervals of time to fresh uninfected animals, and noting the period of time at which trypanosomes appear thereafter in the blood of the animal.

Name of fly fed on infected animal.	When transferred to clean animal.	Trypanosomes appear in blood of clean animal.
<i>Glossina fusca</i>	Immediately.	On 8th day.
" "	After half hour.	On 8th day.
" "	After one hour.	Negative.
" <i>longipennis</i>	Immediately.	"
" "	After half hour.	"
" "	After one hour.	"

This tends to prove that the power of the infected *Glossina fusca* to transmit the infection is limited to less than an hour.

3. Further experiments were carried out with *Glossina fusca* to prove the possibility of this species transmitting the trypanosomes of human sleeping sickness to clean monkeys. One experiment was successful, the trypanosomes appearing in the monkey's blood 29 and 19 days after two lots of the infected flies were fed on it. The importance of this experiment lies in this, that up to the present it has been generally agreed that the only known carrier of the sleeping sickness trypanosome is the *Glossina palpalis*. Colonel Sir David Bruce, in his recent *résumé* of the work and aims of the Uganda Sleeping Sickness Commission, reiterates this fact. Against the weighty issues involved by this experiment must be set the fact that the feeding of the flies was "interrupted," that is to say, not according to the natural habits of the fly, but under more or less arbitrary conditions.

4. Dissections of *Fusca* and *Longipennis* were carried out, both on flies which had fed on clean animals and those which had fed on infected ones, with a view to determining the presence of trypanosomes in the gut. Of those which had fed on clean uninfected animals, a definite percentage was found to have trypanosomes present. Of those which had fed on infected animals very nearly 50 per cent. were found to contain no trypanosome.

5. Of veterinary work a note of various hæmatozoa found in the blood of various game birds and animals is given accompanied by sketches of the parasites.

Dr. Ross brings out the difficulty of distinguishing between East Coast fever—the *Piroplasma parva theileri* and the microscopically indistinguishable *Piroplasma parva mutans*—only to be settled by a blood smear from the spleen. Dr. Small has under investigation a case of lymphangitis in a horse which differs from the recognised type.

6. Good work continues to be done in connection with the production of vaccine, very few tubes having been reported as inert. The quantity supplied would represent the vaccination of some 13,000 individuals, a small item among the inhabitants from Gondokoro to Zanzibar. Owing to the disinclination of the native to volunteer himself for vaccination, some form of compulsion is almost necessary.

The Secretary
to the Administration.

I have, &c.,
A. D. MILNE,
Acting Principal Medical Officer.

LABORATORY, NAIROBI.

HALF-YEAR ANNUAL REPORT, 1ST JULY TO 31ST DECEMBER, 1908.

Experiments with Glossina fusca and Glossina longipennis.

In a previous report (March, 1908) a successful attempt to transmit animal trypanosomes with *Glossina fusca* was described. In this experiment the flies used were fed on arrival at the laboratory on a clean ("fresh fly") dog, and after three or

four days' starvation were half fed on an infected dog, and then allowed to finish their food on a clean dog. As it appeared that *Glossina fusca* was able to transmit the trypanosome under these conditions, a fuller experiment was undertaken to determine how long after its feed on the infected dog the fly was able to carry the disease to a clean animal. In the first place, the previous experiment (interrupted feeding) was repeated. The trypanosomes used had been procured from a naturally infected donkey from which a dog was inoculated.

Experiment 1.—Can *Glossina fusca*, after half feeding on an infected dog, convey trypanosome disease to a clean dog to which it is immediately transferred to finish its feed?

August 13th: Three *Glossina fusca* were fed on "fresh fly" dog No. 138. These flies were not fed again till August 18th, when they were half fed on infected dog No. 139, and then fed on clean dog No. 142. August 25th: The dog's temperature rose to 106° F., and trypanosomes were found in the blood. Incubation period seven days. September 2nd: The dog died, this being the tenth day of the disease.

Post-mortem.—The spleen was enlarged, and there was ulceration of stomach and small intestine. *Tænia* were present.

The "fresh fly" dog No. 138 died on September 16th having shown no sign of trypanosomiasis nor could any sign of this disease be found post-mortem.

Experiment 2.—Can *Glossina fusca* convey trypanosomes from infected to clean dog when there is an interval of half an hour between the feedings?

August 22nd: Three *Glossina fusca* were fed on "fresh fly" dog No. 144, and were not fed again until August 25th, when they were half fed on infected dog No. 141, and after an interval of half an hour, were allowed to finish their meal on clean dog No. 146. September 1st: The temperature of dog No. 145 rose to 103.4° F., but no trypanosomes could be found in the blood. September 2nd: Trypanosomes were found in dog No. 145, incubation period eight days. September 11th: Dog No. 145 died—the tenth day of the disease. *Post-mortem*: The spleen was enlarged and small intestine was ulcerated. There were ecchymoses on the surface of the liver.

The "fresh fly" dog No. 144 died on August 28th of *Piroplasmosis canis*.

The three flies used in this experiment were dissected 48 hours after their last feed and the gut examined. No trypanosomes were found in any one of the three.

Experiment 3.—Can *Glossina fusca* convey trypanosomes from infected to clean dog with an interval of one hour between feedings?

August 4th: Eleven *Glossina fusca* were fed on "fresh fly" dog No. 138. August 7th: Four of the above flies were fed on infected dog No. 139, and after an interval of one hour were fed on clean dog No. 140. August 8th: All the above flies were dissected. Of the seven flies which had fed only on "fresh fly" dog No. 138, five showed no trypanosomes in their gut and two showed the "cultural forms" of trypanosomes. Of the four flies which had also been used in the experiment, three showed no trypanosomes in the gut, and one showed trypanosomes of the type *T. tullocki*. As the experimental dog had not become infected, the experiment was repeated August 26th, but again there was no positive result. "Fresh fly" dog No. 138 died on September 16th without showing any sign of trypanosomiasis either during life or post-mortem.

Experiment 4 was carried out with *Glossina longipennis* with interrupted feeding, but no positive result was obtained.

Experiment 5 was carried out with *Glossina longipennis* with an interval of half an hour between feedings. No positive result was obtained.

Experiments with Glossina fusca and Glossina longipennis and T. gambiense.

In March, 1906, I described an experiment in which *T. gambiense* was conveyed from infected to clean monkey by interrupted feeding with *Glossina fusca*. In this experiment 51 flies were fed over a period of 91 days before the clean monkey showed infection. On getting a further supply of monkeys an attempt was made to repeat this experiment with a smaller number of flies.

Experiment 6.—Can *Glossina fusca* convey *T. gambiense* from infected to clean monkey by interrupted feedings?

September 29th: Six *Glossina fusca* were fed on "fresh fly" dog No. 159. October 2nd: Two of the above flies were fed on infected monkey No. 155, and immediately transferred to clean monkey No. 161, on which they were allowed to finish their feed. October 5th: The two flies used were dissected, and the gut examined. Neither showed trypanosomes. October 13th: Infection not having

taken place, the experiment was repeated with three more flies which had fed on "fresh fly" dog No. 164 on October 8th. October 15th: The three flies used were dissected and the gut examined. One showed trypanosomes of the type *T. tullocki*, the remaining two showed no trypanosomes in the gut. October 30th: The experiment was again repeated with two flies, but on October 31st trypanosomes were found in the blood of monkey No. 161. These last two flies may, therefore, be disregarded. "Fresh fly" dog No. 159 died on October 5th of *Piroplasmosis canis*. It had never shown any signs of trypanosomiasis. "Fresh fly" dog No. 164 died on October 15th, and showed no sign of trypanosomiasis either during life or post-mortem.

Conclusion.—Interrupted feeding with five *Glossina fusca* resulted in infection of the experimental monkey 29 days after feeding the first two flies, and 19 days after feeding the last three flies.

An interrupted feeding experiment with *Glossina longipennis*, and half-hour interval experiments with both *Glossina fusca* and *Glossina longipennis* are being carried out.

(Up to the end of the year these last-mentioned experiments have been unsuccessful. Signed R. Small. January 1st, 1909.)

East Coast Fever.—Owing to the impossibility of deciding whether the ring and rod parasites found in the blood of cattle are true *Theileria parva* of East Coast fever or merely *P. mutans* (Theiler) or a double infection by both parasites, it has been the practice in the laboratory to merely note the presence of the parasites when blood smears are sent for examination. When spleen smears are sent there is no difficulty, the "blue bodies" in the spleen of cases of East Coast fever being quite distinctive. Out of 46 spleen smears, these bodies were found in 44, in the remaining two smears ring and rod parasites were found in numbers, but no "blue bodies" could be found. These bodies are present in the spleen in such quantities in cases of East Coast fever that their absence in these two cases seems to render justifiable a diagnosis of *P. mutans*. In only two cases where ring and rod parasite were found in the blood, and where the cases could be followed carefully, did the animals recover. In these cases, when the blood was first seen, the parasites were found to be fairly plentiful, but frequent blood slides showed that the parasites, instead of increasing till the enormous corpuscular infection which is the rule in East Coast fever was reached, stayed at about the same amount for three or four days, and then gradually disappeared, the animals recovering. In blood smears from two Coke's hartebeest and one bushbuck, small ring form *Piroplasmata* were found. As the parasite of East Coast fever does not persist in the blood of a recovered animal, and it is very improbable that these three animals were shot in the early stage of East Coast fever, it must be to *P. mutans* and not to the *Theileria* that these game parasites are allied, if they are allied to any of the blood parasites of stock.

Verminous Pneumonia of Game.—Verminous pneumonia has now been found in Coke's hartebeest, Thomson's [and] Grant's gazelles, reedbuck, and impala. Captain Neave, who provided most of the specimens, is of opinion that the disease causes the heavy mortality among the game which has been reported as occurring near Donya Sabuk. Portions of the diseased lung, specimens of the adult worms, and smears taken from the lung have been sent to Dr. Leiper, of the London Tropical School, for identification, but no reply has yet been received.

Spirillosis.—No cases of human or bovine spirillosis have been seen, but spirochaetes have been found in the blood of a donkey and of a Chandler's reedbuck. The parasites seen were much smaller than the human spirochaete, being about 10 μ long. Some time ago Mr. Stordy reported a fatal case of spirillosis in the horse which was supposed to have been infected near Donya Sabuk, and it was at Donya Sabuk that the infected reedbuck was shot. In the case of the donkey, the animal was also suffering from piroplasmosis so that the clinical symptoms are of no value.

Trypanosomes in Gut of Glossina fusca and Glossina longipennis.

Glossina fusca.—Forty-one *Glossina fusca* were examined which had fed on a "fresh fly" dog only. Two of these showed "cultural" forms of trypanosomes, and one showed trypanosomes of the type *T. tullocki*. Sixteen flies which had also fed on trypanosome infected animals were also examined; seven of these showed trypanosomes of the type *T. tullocki*, but nothing was found in the remaining nine flies.

Glossina longipennis.—Of 11 flies fed on a “fresh fly” dog, “cultural” forms were found in one fly. Of the 15 flies also fed on various infected animals, trypanosomes of the type *T. tullocki* were found in five flies and “cultural” forms in one fly. The *Glossina longipennis* would appear to harbour the same forms of trypanosomes in its gut as do the *Glossina fusca*. As pointed out in previous reports, the feeding of these flies would appear to have nothing to do with the presence of trypanosomes in their gut. In any batch of flies fed on the same trypanosome infected animal under exactly the same conditions, one would expect that all the flies would become infected had the trypanosomes ingested from the infected animal anything to do with those in the gut of the fly. But this is practically never the case.

Parasites of Game.—Many more blood slides of game have been sent in, and my thanks are again due to Messrs. Percival and Goldfinch, and also to Mr. Scholefield, who has supplied me with a very large number of slides. In the last report a leucocytozoon was described as occurring in various birds. The same parasite, or one so closely resembling it as to be indistinguishable, has again been found in the spur fowl (1), the *Francolinus uluensis* (2), and in a partridge (*Francolinus*) (2), considered by Mr. Scholefield, who sent the blood smears, as probably a new species. Besides the leucocytozoa, one *Francolinus* showed large microfilaria and trypanosomes. In a lesser bustard there was found an halteridium; in Coke's hartebeest (2) and bushbuck (1) *P. mutans* (?) were found, and spirochætes have been found in a reedbuck.

P. H. Ross,
Bacteriologist.

November 19, 1908.

VETERINARY EXPERIMENTS.

My attention was called to a horse which was suffering from a chronic form of lymphangitis. Several other cases had been seen and examined for the cryptococcus of Rivolta with a negative result. The disease, epizootic lymphangitis, caused by the above-named organism was very closely simulated by that from which these horses were suffering. A short bacillus staining by Gram with the morphological characteristics of the organism described by Nocard as causing ulcerative lymphangitis was found.

A guinea-pig was injected intra-peritoneally, and Straus's reaction was obtained. Several other cases were examined, and the same organism obtained from all. In one case a spore-like form was seen. The pus from this case was, after heating to 80° C. for three-quarters of an hour, injected intra-peritoneally into a guinea-pig and subcutaneously into a donkey. There was no result in either case. This investigation is still in progress.

Routine Work. November 1st to December 31st.

During the last two months of the year, 311 examinations have been made, of which 171 proved negative. These latter represent a very large expenditure of time, as before a specimen can be pronounced negative an exhaustive search must be made.

The light of this country is very trying to the eyes, owing to the fact that very often for long periods the sky is practically cloudless. The work would be, therefore, very greatly expedited by the installation of three or four electric table lights, which, moreover, would give a better colour contrast and a more constant illumination of the field.

A considerable number of the slides included under the heading “Negative” were taken after putrefaction had set in, and no opinion could be formed although in East Coast fever the “blue bodies” in the spleen can be distinguished for some time after the blood and tissue cells have become obliterated. Another considerable number placed under this heading, had been unskillfully taken, and the corpuscles had become so crenated as to render it hopeless to find parasites in them. I have no doubt, however, that a knowledge of taking slides correctly will shortly spread greatly among farmers and others, and we shall thus be supplied with a greater quantity of useful material from other than trained officials.

The amount of vaccine lymph supplied during the last six months is as follows:—

To East Africa and Uganda	262 dozen tubes.
To Zanzibar	100 „ „
Total	362 „ „

R. SMALL,
Acting Bacteriologist.

HUMAN.

<i>1st July to 31st October.</i>		<i>1st November to 31st December.</i>	
Negative Slides	23	Negative Slides	16
Malaria Subtertian	30	Malaria Subtertian	4
(2 crescents.)			
Malaria Quartan	2	Malaria Quartan	2
Malaria Benign Tertian	1		
Differential Leucocyte Counts ...	36	Differential Leucocyte Counts ...	17
Differential Leucocyte showing		Differential Leucocyte showing	
L.M.Ns. pigmented	15	L.M.Ns. pigmented	6
Sputa for T.B.	6	Sputa for T.B.	4
(2 positive.)			
Pneumonia lung smears	6	Pneumonia lung smears	4
Tænia saginata	1		
Urines	8	Urines	11
T. Gambiense	1		
Gland punctures	2		
(Negative.)			
Gonococcus	2	Gonococcus	3
Widals—		Widals—	
Positive	2	Positive	1
Negative	1	Negative	2
Water Analyses	16	Water Analyses	3
Quartz for gold	1		
(Cu. & Fe. Pyrites.)			
Sections—		Sections—	
Keloid-Fibroma.		Uterus Placental tissue	1
Snipping from Cervix Urteri (fibrous		Alveolar Ulcer Spirilla	1
tissue).		Bilharzia Hæmatobia. Terminal	
Uterine mucous membrane (fibrous		spine	1
tissue).		Double infection. Tick fever and	
Uterine scraping. Blood clot.		malaria	1
Brain. Subtertian Malaria.			
Spleen. Subtertian Malaria.			

VETERINARY.

<i>1st July to 31st October.</i>		<i>1st November to 31st December.</i>	
Negative	292	Negative	151
Piroplasmoses—		Piroplasmoses—	
Theileria	44	Blue bodies	16
Rings and Rods ? Theileria ...	68	Rings and Rods	32
" " P. Bigeminum	4	Marginal points	1
P. Bigeminum	3	P. Bigeminum	1
P. Canis	4	P. Canis	2
P. Equi—horse	2	P. Equi—donkey	2
" donkey	3	P. Ovis	1
" mule	1	Trypanosomes—cattle	7
Trypanosomes—cattle	4	Ulcerative lymphangitis—horse ...	6
" donkey	1	" " mule	1
" mule	1	Double infection—	
Tubercle—goat	1	Trypanosomes and piroplasma in	
Analyses for strychnine	1	cattle	1
(Negative.)		Bacillus septicæmiæ hæmorrhagicæ ...	1

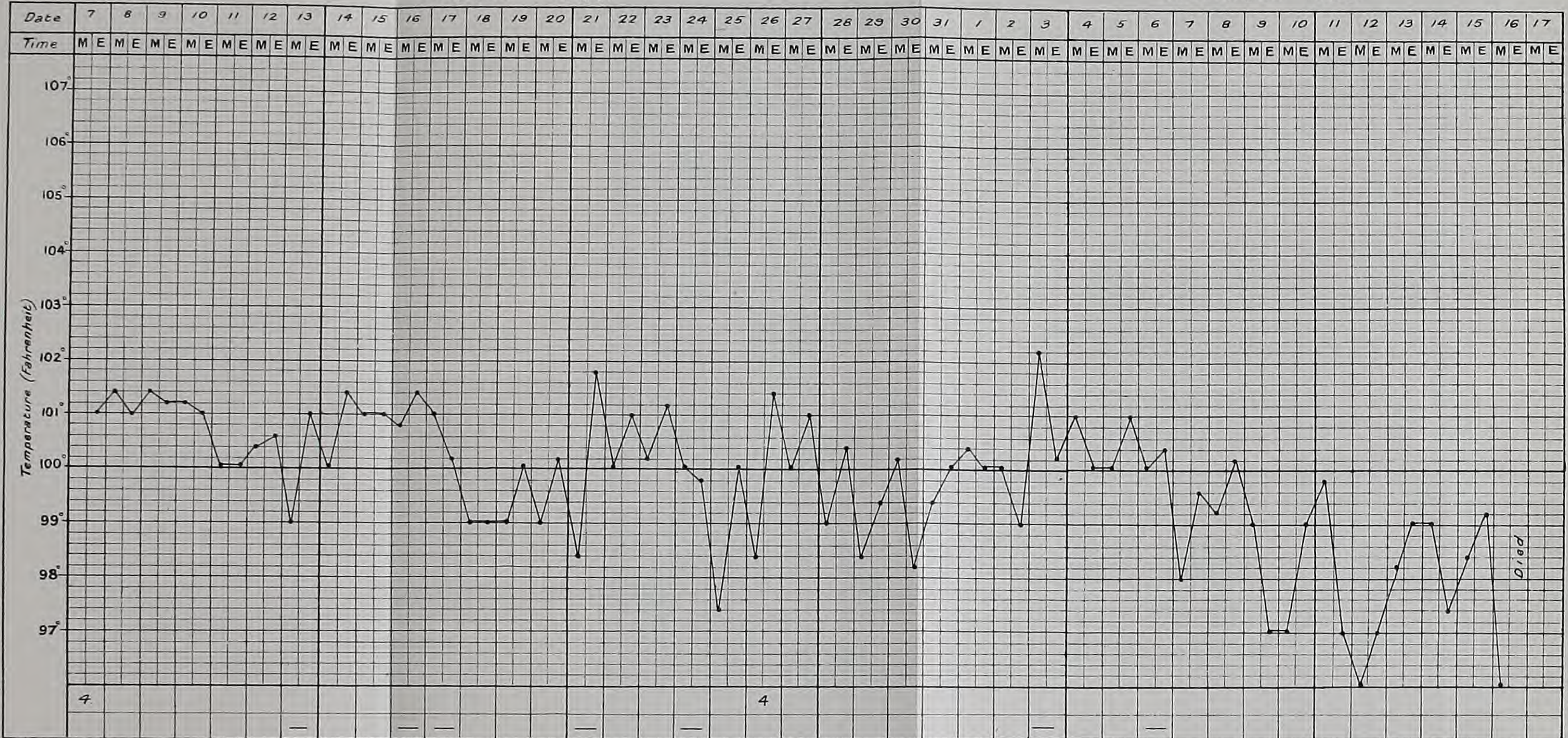
Sections—	Anæmia	...	...	...	...	5
Liver, goat, nil.	Sections—					
Kidney, goat, glomerular nephritis.	Verminous pneumonia	...	...	...	...	1
Thomson's Gazelle, lung.	(Negative.)					
(Verminous pneumonia.)						

GAME.

1st July to 31st October.				1st November to 31st December.			
Thomson's gazelle blood	...	...	...	4	Thomson's gazelle	...	1
(Negative.)					(? Piroplasmosis.)		
Thomson's gazelle lung	...	...	...	5	Negative	...	4
(Verminous pneumonia.)							
Grant's gazelle blood	...	...	...	1			
(Negative.)							
Impala blood	...	...	...	3			
(Negative.)							
Impala lung	...	...	...	1			
(Verminous pneumonia.)							
Oryx blood	...	...	...	1			
(Negative.)							
Lion blood	...	...	...	2			
(Marked anæmia.)							
Lesser bustard blood	...	...	...	1			
(Halteridium.)							
Spur fowl blood	...	...	...	1			
(Negative.)							
Spur fowl blood	...	...	...	1			
(Leucocytozoon.)							
Waterbuck blood	...	...	...	1			
(Negative.)							
Duiker blood	...	...	...	1			
(Negative.)							
Coke's hartebeest blood	...	...	...	4			
(Negative.)							
Coke's hartebeest blood	...	...	...	2			
(P. mutans ?)							
Buffalo blood	...	...	...	1			
(Negative.)							
Francolinus uluensis blood	...	...	...	1			
(Filaria, trypanosome, leucocytozoon.)							
Francolinus uluensis blood	...	...	...	1			
(Leucocytozoon.)							
Guinea fowl blood	...	...	...	1			
(Negative.)							
Steinbuck blood	...	...	...	1			
(Negative.)							
Grouse blood	...	...	...	1			
(Negative.)							
Zebra blood	...	...	...	1			
(Negative.)							
Hirax blood	...	...	...	2			
(Negative.)							
Bushbuck blood	...	...	...	1			
(P. mutans ?)							
Reedbuck blood	...	...	...	1			
(Spirochaeta.)							
Oribi blood	...	...	...	1			
(Negative.)							
Francolinus (? new) blood	...	...	...	2			
(Leucocytozoon.)							

AUGUST 1908.

SEPTEMBER 1908.



Number 140

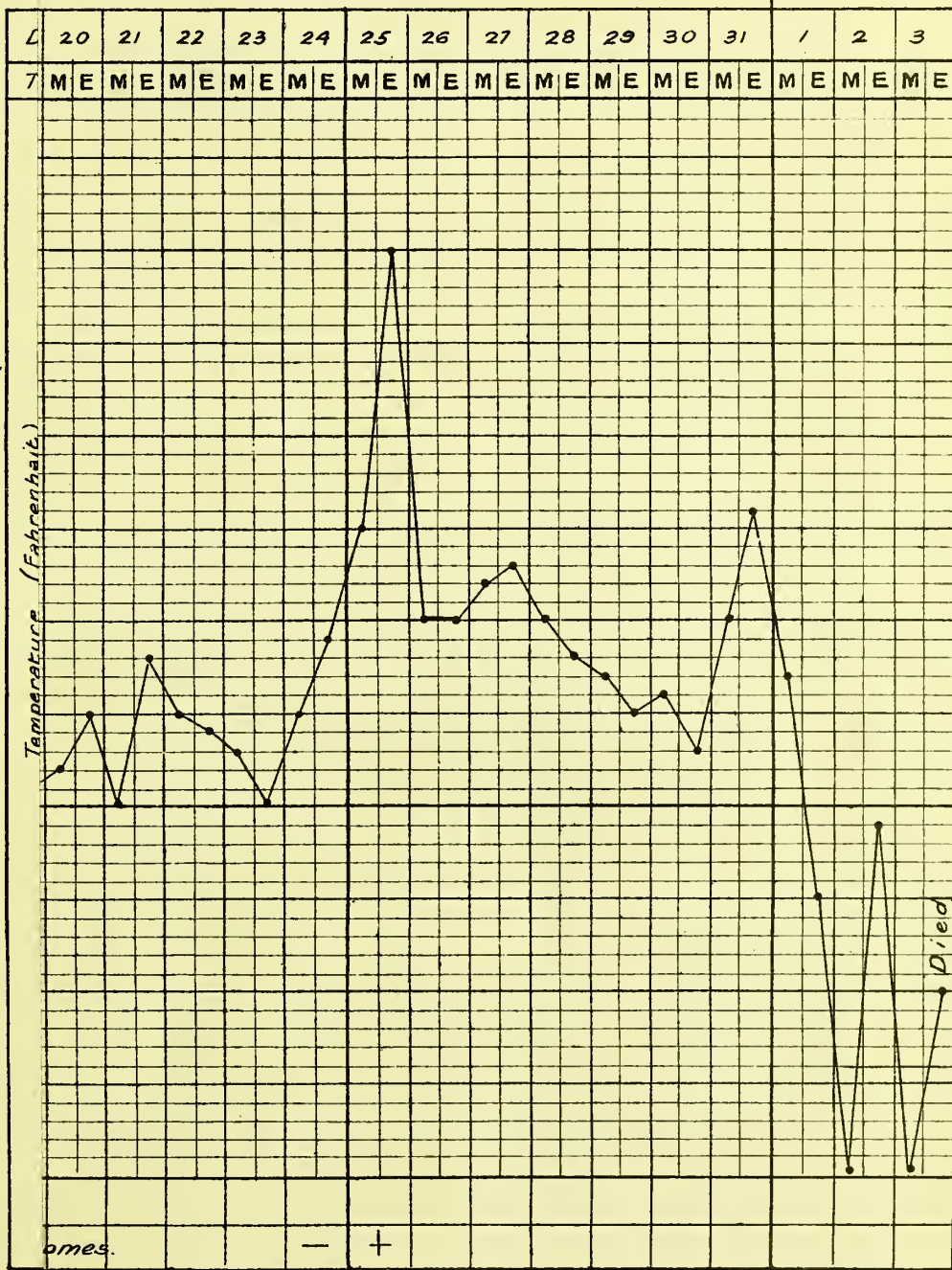
Description. Clean dog

Remarks.

No of infected Flies Fed

AUGUST 1908

SEPTEMBER 1908.



Weller & Graham Ltd Litho London

umber 142

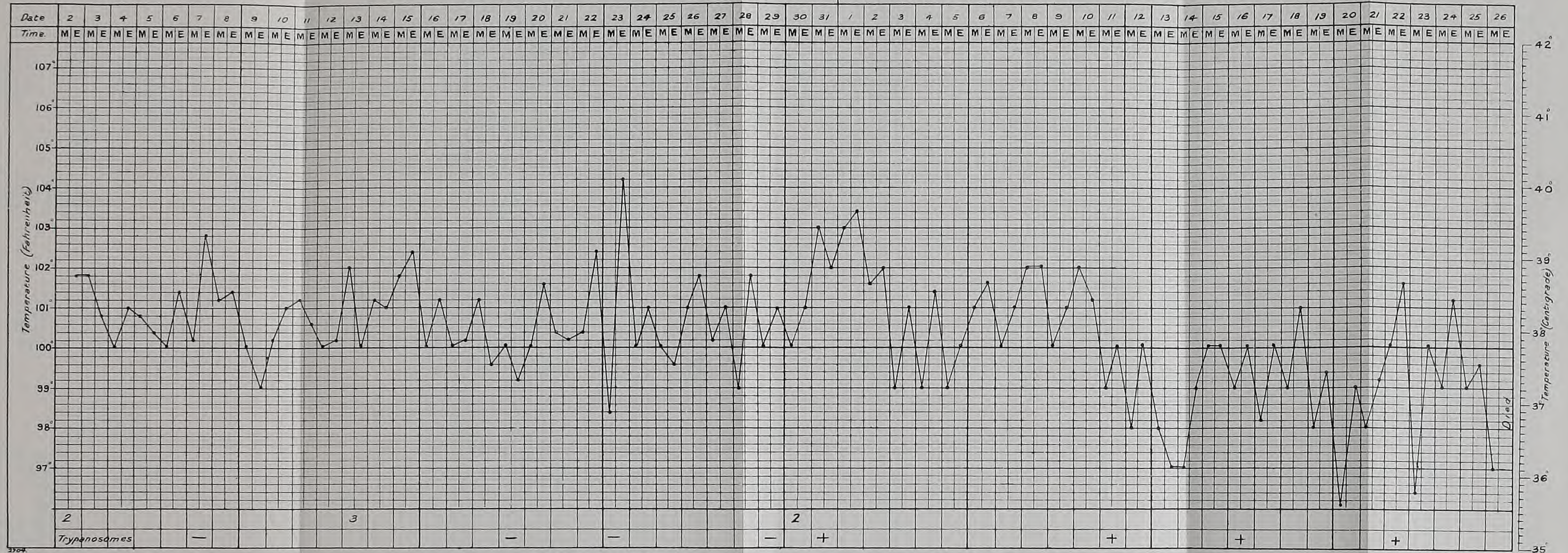
escription. Brown dog

emarks

of infected flies fed

OCTOBER 1908.

NOVEMBER 1908.



P.M. Spleen enlarged, ulceration in the guts & stomach, black patches on the lungs.

Weller & Graham, Ltd. Litho London

SPUR FOWL.

LEUCOCYTOZOA.



Trypanosomata.

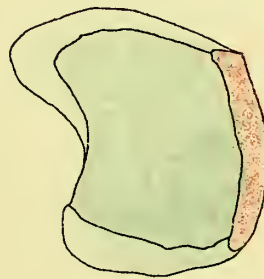
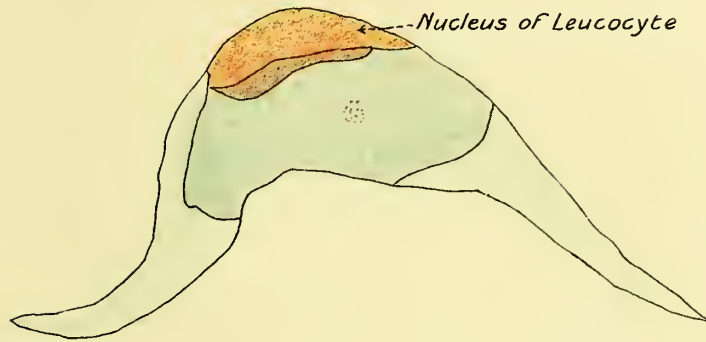


Coke's Hartebeest *Piroplasmata*

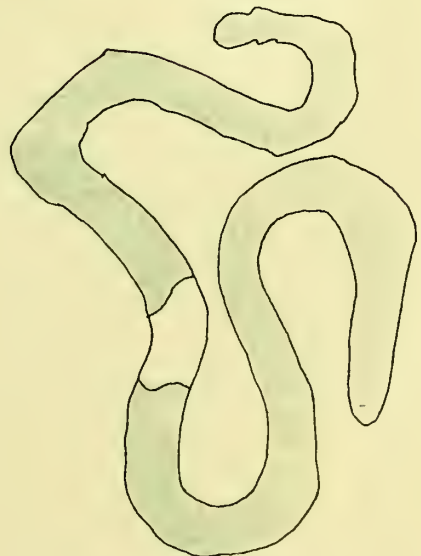


FRANCOLINUS ULUENSIS.

LEUCOCYTOZOA



Micro Filaria.



Trypanosoma.



FRANCOLINUS ULUENSIS.

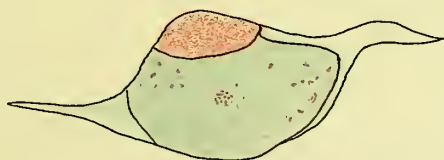
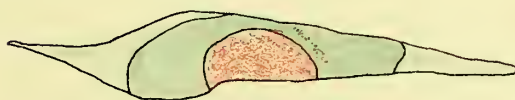
LEUCOCYTOZOA



GUINEA FOWL LEUCOCYTOZOA.



Free form.



No. 7.

EAST AFRICA PROTECTORATE.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 6 November, 1909.)

MY LORD,

Government House, Nairobi, October 6th, 1909.

I HAVE the honour to transmit herewith the report of the work done in the Nairobi Laboratory for the half-year ending June 30th, together with a covering letter from the Principal Medical Officer.

2. Your Lordship will observe that many interesting and valuable experiments have been carried out, more especially with regard to the causes of East Coast Fever.

I have, &c.,

E. P. C. GIROUARD,

Governor.

Enclosure in No. 7.

NAIROBI LABORATORY REPORT, JANUARY-JUNE, 30, 1909.

For the first four months of the year the work of the laboratory was carried on by Dr. Small during my absence on leave. This period is dealt with by Dr. Small in the annexed report. Owing to the outbreak of small-pox and the consequent demand for vaccine a great deal of time during the months of May and June was taken up with vaccine preparation.

Vaccine.

The preparation of vaccine was continued with the strains described by Dr. Small. The prolongation of the incubation period has not been done away with, but, judging by the results of vaccination during the recent outbreak of small-pox in Nairobi, the protective value of the lymph is not diminished, though delay in "taking" must always be a disadvantage in dealing with contacts. The strain derived from small-pox patients has been carried to the sixth calf, and it remains to be seen if there will be the same delay with this strain. During the months of May and June 8,064 tubes of vaccine, equivalent to at least 32,256 vaccinations, were issued from the laboratory.

Congo Floor Maggot.

Kiswahili—Mabú.

Kikamba—Kiragu.

Kikuyu—Mianya.

Kilumwa—Nyandinik.

The Congo floor maggot was found by Dr. Wiggins in Nairobi goal. I was able to procure specimens, and find that it is well known to the natives apparently all the way from the coast to Uganda.

Ornithodoros.

Kiswahili—Papasi.

Kikamba—Kútungu.

Kikuyu—Ngumba.

A large number of *Ornithodoros moubata* were obtained from near Nyeri. The Swahili, Wakamba, and Wakikuyu recognise this tick, but though some of them refer to immediate effects of the bite—local pain, swelling, and itching—they do not attribute to the bite any more remote ill effects. The Wakamba say that its usual habitat is beneath stones, especially near rivers, and that it is not usually found in native huts except in old deserted ones. The first specimens seen by me in East Africa were caught in the open veldt in the Kidong Valley during a mid-day halt.

Of the ticks brought from Nyeri, eight or ten were incubated all night and next morning fed on a monkey, this being repeated with fresh batches every day until forty-five in all had fed. As the monkey's temperature remained normal the ticks were apparently not infected. All these ticks were finally sent to Professor Nuttall for use in his experiments.

Epizootic Lymphangitis.

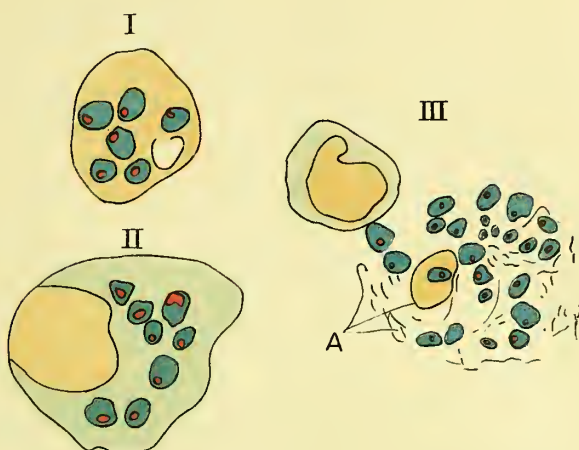
On June 1st smears from a swelling on a mule were sent to the laboratory for examination. Stained by the method of Claudius these showed typical cryptococci of Rivolta. Other smears were stained by Leishman's method; and it then appeared that one was dealing not with a yeast but with a protozoal parasite. Some of the discharge from the swelling was collected in 1 per cent. citrate for further study, which was continued while the supply lasted, photographs and drawings being made. I have since received the *Annales de l'Institut Pasteur* for May, and find that the view that the parasite is a protozoon has already been put forward by Ducloux, Thiroux, and Teppaz. It will be seen that my observations agree closely with those of the latter authors.

In the smears from the swelling numerous bodies 1.5μ to 3.5μ in greatest width, ovoid, oval, or circular in shape were seen. In each was a large mass of chromatin laced excentrically, and the rest of the body stained blue—an area near the chromatin being less deeply stained than the rest. The chromatin mass appeared to be situated to one side of an area slightly lighter in colour than the rest of the protoplasm. A few of these bodies were free between the cells, but the great majority were contained within the large mononuclear and polymorphonuclear leucocytes. Many were in groups clearly formed by the breaking down of a leucocyte, the group consisting of parasites and nuclear material from the leucocyte. Some of the leucocytes contained only one or two parasites, but many were crowded with them, containing as many as 10 or 12, one broken down group (v. fig.) showing 24 parasites. The free form showed a well-marked capsule, but this was rarely seen in parasites still within the leucocytes, the most to be seen, as a rule, in the case of these latter being a clear area between the parasite and the surrounding protoplasm.

Examination of wet specimens of the citrated material showed the parasites as large numbers of roundish bodies chiefly within the leucocytes. Within these bodies to one side or end was an area clearer than the rest of the body, and within this clear area a dancing granule could be seen. The periphery of the parasite did not show any definite capsule. The citrated material was examined daily. For the first three days there seemed to be an increase in the number of parasites, judging, however, only from the appearance of stained smears made from the material; for no development was ever observed, although fields showing many parasites with very active granules were kept under observation for several hours. No sign of budding was ever found either in fresh or stained specimens, nor was there ever any hint of a flagellated form. After the third day there came a gradual diminution in the number of the parasites and disappearance of the leucocytes, so that latterly only free parasites could be seen. After the ninth day the citrated material became covered with moulds, and further observation was impossible, but up to and including the ninth day there could still be seen live parasites—that is parasites in which the granule could be seen to be active. The individual parasites, whether seen in stained or in wet specimens, had exactly the same appearance on the ninth day as had those seen on the first day.

The appearance of the parasite when stained with Leishman was so clearly that of a protozoon that the question at once suggested itself, "Is the parasites' presence in the leucocytes due to phagocytosis or is it a parasite of the leucocyte?" The fact that the leucocytes so frequently became so crowded with the parasites as to be destroyed made it seem more probable that the parasite developed within them. Had the presence of these bodies within the leucocytes been due to phagocytosis one would be inclined to expect that since such a very marked phagocytosis was set up by the presence of the parasites, removal of all visible disease by scraping, cautery, or excision would result in cure of the disease, the phagocytes being able to deal with whatever parasites might be left behind. But this is, of course, seldom the case, the disease frequently recurring further up the lymphatic. These observations agree with those of Thiroux and Teppaz, except that they tried to grow the parasite on various media and I tried to get development in citrate solution. In their attempts, as in mine, there was an apparent

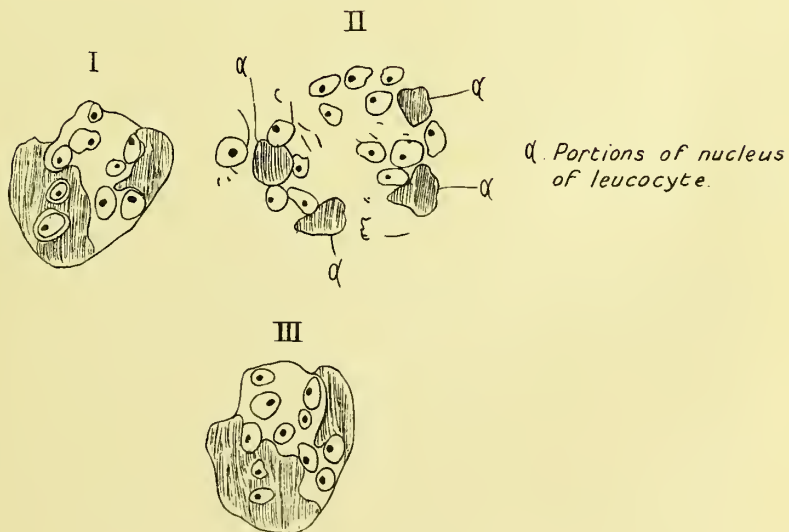
EPIZOOTIC LYMPHANGITIS.



A. Remains of nucleus.

I and II. Parasites in polymorphonuclear and large mononuclear leucocytes.
freshly taken smear.

III. After five days in citrate solution



I and III Parasites in leucocyte.

II Leucocyte broken down releasing parasites



increase at first, perhaps only due to escape of the parasites from the leucocytes, and not a real increase. In my case observation of individual parasites prolonged over several hours failed to detect any sign of development.

The French writers further note a similarity between this parasite and *Heliosoma tropicum*, they offer an explanation of the formation of the capsule seen in free specimens—that it is due to coagulation of the albuminous material in which the parasites are bathed and retraction of the parasite from this coagulated wall—and finally they note the name “Leucocytozoon piroplasmoïdes.”

Trypanosome transmission experiments.

The three experiments on transmitting *T. gambiense* have been ended with a view to carrying out experiments on the lines of Kleine's work. Of these experiments one—interrupted feeding with *Gl. longipennis*—was ended by the death of the monkey—not of trypanosomiasis—after 297 flies had been fed during a period of 252 days.

In the second experiment (half-hour interval) 232 *Gl. longipennis* were fed during a period of 188 days. This monkey is alive and uninfected.

In the third experiment (half-hour interval) 237 *Gl. fusca* were fed during a period of 195 days. This monkey is also alive and uninfected.

East Coast Fever

I first saw Koch's granules, or as we call them locally “blue bodies,” in 1904. As a result of many examinations I came to the conclusion that the presence of these bodies was pathognomic of the disease, and for some years a positive diagnosis of East Coast Fever has been given only when these bodies were found. As Koch stated that these bodies are present in spleen and glands before the intracorpuseular parasites appear in the peripheral blood, Dr. Small devised a method of spleen puncture which has been made considerable use of locally. This procedure has been of the greatest use to determine a diagnosis in doubtful cases where only a few ring and rod parasites could be found in blood smears. Before this method was introduced such cases were regarded as suspicious until they either died or recovered. If they recovered the presumption was that they had been suffering from *P. mutans*; if they died blue bodies could almost invariably be found in the spleen. In only two cases in my experience were these bodies absent from the spleen after death of animals whose blood had shown a high infection with ring and rod parasites. A further use might be made of Dr. Small's method in determining what percentage of animals attacked by East Coast Fever in this country recover. Dr. Small also arranged for smears from spleens of cattle slaughtered at the local abattoir. In one of his series of 168 smears and in two of my series of 120 smears blue bodies were found; in the latter cases the temperatures unfortunately were not sent.

PHILIP H. ROSS,
Bacteriologist.

August 14, 1909.

Human Examinations.

— — —	January 1st to April 30th.	May 1st to June 30th.
Negative	42	19
<i>Malaria.</i>		
Sub-tertian	4	6
Benign tertian	2	2
Quartan	2	2
<i>Differential leucocyte counts.</i>		
(a) Large mononuclear increase and pigment.	4	2
Carried forward ...	54	31

— — —	January 1st to April 30th.				May 1st to June 30th.
<i>Differential leucocyte counts—cont.</i>					
Brought forward ...	54				31
(b) No L.M.N. increase, non pigment.	3	...	...	...	19
Sputa for tubercle ...	1	...	...	...	1
" " " " " " " " " "	7	...	...	...	4
Pneumococci ...	1	...	...	...	0
Widal tests ...	4	...	...	...	4
" " " " " " " " " "	4	...	...	...	1
Plague ...	1	...	...	...	—
" " " " " " " " " "	2	...	...	...	—
T. "Gambiense ...	4	...	...	...	—
Gonococcus ...	2	...	...	...	5
" " " " " " " " " "	1	...	...	...	—
Anæmic ...	1	...	...	...	—
Urine ...	2	{ Gonococcus ... Chemical and microscopical. Bilharzia ...			1 11 1
Fæces ...	1	...	...	...	1
Semen ...	1	...	...	...	—
Water Analysis ...	6	...	...	...	4
Anthrax ...	—	...	...	...	1
Sections of tissues ...	1	...	...	...	8
Various ...	—	...	...	...	2
Total ...	96				94

Veterinary Examination.

Negatives ...	647	...	...	...	318
<i>Piroplasmoses.</i>					
1 cattle. Rings and rods	58	...	...	...	24 (of which 1 showed <i>P. bigeminum</i> and 1 Spirochaetes in addition.)
Blue bodies ...	86 in Smears P. M.				23 (2 <i>P. bigeminum</i>)
<i>P. Bigeminum</i> ...	By spleen puncture.				23 (2 <i>P. bigeminum</i>)
" " " " " " " " " "	4 In blood. ...				3
" " " " " " " " " "	0 P. M. ...				2
" " " " " " " " " "	0 Spleen punctures ...				2
Marginal points ...	1	...	...	...	—
<i>P. equi</i> (donkey) ...	2	...	...	...	1 (mule)
<i>P. ovis</i> ...	1	...	...	...	—
<i>P. canis</i> ...	1	...	...	...	2
Trypanosomes Cattle ...	1	...	...	...	6
Horse ...	16	...	...	...	2 (donkeys)
Mule ...	1	...	...	...	—
Anæmia ...	14	...	...	...	13
Ulcerative lymphangitis	23	...	...	...	4
Tubercle (fowl) ...	2	...	...	...	1
Spirochaete (mule) ...	1	...	...	...	—
Ostrich (nil) ...	1	...	...	...	—
Anthrax (ox) ...	1	...	...	...	—
Spleen smears from slaughter-house.	—	...	...	...	120
<i>Epizootic lymphangitis</i>	—	...	...	...	1
Total ...	860				545
Sections Texas Fever Spleen.	1	...	...	...	1 Ulcerative Lymphangitis.
Testicle, Guinea pig ...	1	...	...	...	—
Fowl liver ...	1	...	...	...	—
Anthrax spleen and kidney.	2	...	...	...	—
Calcified glands of ox ...	1	...	...	...	—
Pharyngeal ...	1	...	...	...	—
Thickened large intestine.	1	...	...	...	—
Caseated lung, sheep ...	1	...	...	...	—
Caseated lung, calf ...	1	...	...	...	—
Liver of fowl (T.B.) ...	1	...	...	...	—
Total ...	871				546

Game.

	Result.	Negative.	Total.
<i>January 1st to April 30th.</i>			
Thomson's Gazelle	—	4	4
Kongoni, Anaemia	2	—	}
Kongoni, Cysticercus	1	1	
Reedbuck	—	3	3
Colobus Monkey, Spirochoete	1	—	1
Waterbuck... ..	—	1	1
Jackson's Hartebeest	—	1	1
Elephant	—	1	1
Zebra	—	4	4
Duiker	—	2	2
Small Green Monkey, Haemamaebakochi ...	1	—	1
Syke's Monkey, Haemamaebakochi ...	1	—	1
Bush Pig	—	1	1
Oribi	—	1	1
Hare	—	1	1
Wild Pigeon, Halteridium	1	—	1
Green Pigeon	—	2	2
Stork	—	1	1
Florican, Proteosoma	1	—	1
Guinea Fowl	—	3	3
L. Bustard, Proteosoma	1	—	1
Spur Fowl	—	1	1
Red Winged Partridges, Leucoocytozoon ...	1	—	1
			37
<i>May 1st to June 30th.</i>			
Guinea Fowl, Halteridium	5	1	6
Jerboa	—	5	5
Total ...			48

NAIROBI LABORATORY REPORT.

January 1st to April 30th, 1909.

The experiments in transmission of *T. gambiense* by means of *G. fusca* and *longipennis*, as described in former reports, have been continued.

- (1) *G. fusca*, with half-an-hour interval (142 flies used).
- (2) *G. longipennis*, " " (125 ").
- (3) " interrupted (141 flies used).

These experiments have been up to the present time unsuccessful.

Some difficulty has been experienced in maintaining a sufficient supply of monkeys for experimental purposes owing to the high mortality during transit and shortly after arrival.

Suitable hutches have now been obtained and should help to obviate this difficulty.

Vaccine.

It was noticed that the incubation period of the strain of lymph in use here was unduly prolonged. Fresh seed lymph was immediately cabled for and was expected to arrive on April 22nd. A supply was also sent for from Dar-es-salaam, and 100 tubes of glycerinated lymph prepared in Dresden obtained.

In the meanwhile an attempt was made to exalt the virulence of the old strain by direct inoculation through a series of calves, and afterwards two calves were inoculated from particularly good vesicles on healthy human subjects.

These methods were only partially successful in that, although the vesiculation became more typical, the incubation period still remained longer than normal. On the appearance of smallpox in the country a calf was inoculated with lymph obtained from several bad confluent cases.

The fourth calf of this series has now been reached, but it is too early to make any report about this strain.

Two small tubes of dried lymph from the "Institut Sero-therapique and vaccinal Suisse" at Berne were received and a series of three calves inoculated; the result being unsatisfactory this strain was discontinued. Some "ivory points," obtained locally, were tested on the human subject and gave no reaction. The vaccine at present issued by this laboratory is derived from the following sources:—

- (1) Lister Institute (the original strain);
- (2) Dresden lymph from Dar-es-salaam.

During the period covered by this report lymph equivalent to 71,706 tubes has been issued, of which 1,308 were supplied to Zanzibar.

East Coast Fever.

Several small outbreaks of this disease have occurred. With a view to showing that Koch's granules or blue bodies are not found in spleen smears from cattle not suffering from East Coast fever, all animals slaughtered in Nairobi since last December have been so examined. Blue bodies were found in several cases, and as all these animals were examined previous to being slaughtered by an experienced inspector they may be presumed to have been apparently healthy. Arrangements were then made with the Chief Veterinary Officer to have the temperature of each such animal taken and recorded on its respective slides.

During the first four months of the year 168 such slides were examined, blue bodies being found in one only whose temperature was 107 F. and whose red cells showed a large infection of rings and rods.

As the diagnosis of East Coast fever has been for some time in this Protectorate based on the presence of blue bodies, particularly in the spleen, and a means of diagnosis during life being desirable, a method of spleen puncture has been elaborated. This operation is simple and bad results have not yet been reported. Up to the present, 162 such examinations have been made by veterinary officers, and, after a little instruction, by stock inspectors also. In several cases repeated punctures have been made on the same animal, apparently harm ensuing. The method is as follows:—

The hair being removed from the spot and the skin cleansed, a small stab is made through the cuticle with a scalpel about an inch internal to the outer border of the longissimus muscle in the second intercostal space from the costal margin. A fairly large bore hypodermic needle is inserted into the cut and driven sharply inwards and forwards. The capsule of the spleen being somewhat tough, it is found convenient to drive the needle in with a sharp tap to avoid simply scratching the capsule and pushing the spleen aside. The syringe is then attached, and a little fluid drawn into the barrel. The needle is then withdrawn and the fluid squirted into a sheet of white paper on which the spleen pulp is easily seen and a satisfactory smear of it can be made. The whole operation should, of course, be performed with due attention to cleanliness. Of these 162 punctures, 62 were taken from the survivors of a herd of infected cattle some three weeks after the last death; no blue bodies were found, and rings and rods in only two. In 47 taken on a farm from which several cases at long intervals had been reported, one showed bodies which although not typical were strongly suggestive of blue bodies; the animal was in very poor condition; four showed rings and rods. In an animal placed on infected ground blue bodies were found on the first day of the disease.

Ulcerative Lymphangitis.

This disease is still prevalent, the bacillus having been found in 23 examinations. Acting on a case reported by Valter, in which improvement had followed the administration hypodermically of antidiaphtheritic serum, the Chief Veterinary Officer obtained a supply, and the investigation of its value is now being carried out without, however, much success. An attempt was made to procure a high state of immunity to this organism in two donkeys. Unfortunately, however, before the conclusion of the experiment the animals died of an intercurrent disease. Two bullocks were also inoculated, and a local lesion only produced in both cases from which the bacillus was recovered.

Experimental work in this and other directions has been greatly impeded by the large amount of routine work and latterly by necessity of vaccine production on a large scale.

R. SMALL,
Acting Bacteriologist.

Enclosure 2 in No. 7.

SIR, Principal Medical Officer's Office, Nairobi, 22nd September, 1909.

I HAVE the honour to transmit the half-yearly report on the work done in the laboratory for the six months ending June 30th. The delay in forwarding the report has been due to my absence on inspection duty.

The work of the laboratory was much interfered with owing to the outbreak of smallpox, which practically confined for many weeks the whole efforts of the staff to the preparation of vaccine.

The trypanosome experiments mentioned in the last report, namely, those conducted with a view to determine how long the tsetse flies, *Glossina fusca* and *longipennis* could carry the infection of *Trypanosoma gambiense*, have been abandoned. The net result of the experiments is negative; that is to say, if there is any delay in transferring an infected *fusca* or *longipennis* to a clean animal, *Trypanosoma gambiense* does not assert itself in the blood of that animal.

The range of the *Ornithodoros moubata* (the tick that carries spirillum fever) and the Congo Floor maggot has been further extended. It is more than probable that both these will be ultimately proved to inhabit all parts of the Protectorate. The danger of this lies in the risk of the ticks becoming infected with the *Spirochaeta Duttoni*, and so spreading tick fever. In the last four years only one sporadic case has been brought to notice.

The cause of the epizootic lymphangitis described by Dr. Ross is, in his opinion, due to a definite protozoon which he describes at some length as inhabiting chiefly the leucocytes. Though efforts to cultivate the parasite in media failed, he does not consider that their presence in the leucocytes is merely mechanical, *i.e.*, due to phagocytosis. An attempt to immunise donkeys so as to obtain a serum for injection proved abortive.

Investigations into the cause of East Coast fever have been continued. Both Dr. Ross and Dr. Small, who devoted a good deal of time to the subject, agree that the presence of Koch's granules or "blue bodies" in a spleen smear taken from a dead animal are pathognomonic of East Coast fever. Following up this idea, Dr. Small instituted a method of spleen puncture in the living animal; an operation which, though looked upon with suspicion on the human subject, can be apparently performed with impunity on cattle. The value of this as a method of diagnosis can hardly be over-estimated, as it enables an operator to at once decide whether a herd is infected or not, or what animals will succumb.

The usual statistical tables are appended detailing the ordinary routine examinations performed, both medical and veterinary.

I have, &c.,
R. B. MILNE,
Principal Medical Officer.

The Secretary to the Administration,
Nairobi.

No. 8.

FEDERATED MALAY STATES.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 27 November, 1909.)

MY LORD, Government House, Singapore, 2nd November, 1909.

I HAVE the honour to transmit a copy of a letter from the Resident-General forwarding the report of the Director of the Institute of Medical Research on the working of the Institute for the period 1st April to the 30th September, 1909.

2. The results obtained in regard to beri-beri are of the highest importance. When the investigations are completed, if they confirm the conclusion derived from

these results, it will be incumbent on the Government to take active measures to discourage the use of white rice in the Colony and Federated Malay States by means of a heavy import duty or even total prohibition.

3. It will, of course, continue to be manufactured for use in Europe, and in countries where it forms only an occasional article of diet, and does not, as here, form the staple food of the population.

I have, &c.,
JOHN ANDERSON.

Enclosure in No. 8.

SIR, Kuala Lumpur, Federated Malay States, 22nd October, 1909.

I HAVE the honour to forward to Your Excellency the Report of the Director of the Institute of Medical Research on the working of the Institute for the period 1st April to the 30th September, 1909.

2. I would particularly invite Your Excellency's attention to the results attained by the Director and his colleagues with respect to beri-beri. I understand from Dr. Fraser that he is satisfied there can be no doubt as to the disease being caused by the absence from what are known as Siamese and Rangoon rices of certain nutritive qualities that would appear to be removed in the milling.

3. In view of this it would appear to be desirable to discourage, as far as may be possible, consumption of these rices by the inhabitants of this country. The simplest way to effect this would be, in my opinion, the imposition of such a moderate import duty as would place these undesirable rices at a disadvantage with the qualities both imported and locally prepared that are not open to objection.

4. If Your Excellency approves I have no doubt that I could, in conjunction with Dr. Fraser, frame such a description of the rices to which I refer that no difficulty would be experienced by our officers in classifying them and levying duty on them.

5. I anticipate that the imposition of a duty would lead to a cessation of the import of Siam and Rangoon rices, or, if the quantity imported is so large as to make it worth while, would lead to such a change in the mode of preparation as would remove objection to their consumption by the people.

6. I need not remind Your Excellency how a large proportion of our working classes consume these mischievous qualities of rice, and how much sickness and suffering result, assuming, as I believe we must, the soundness of the theory of the rice causation of beri-beri.

7. To Dr. Braddon, who has for years insisted on the disease being caused by the consumption of rice, it must be a subject of congratulation that his opinion and theories have received such confirmation.

I have, &c.,
W. T. TAYLOR,
Resident-General.

His Excellency the High Commissioner,
Federated Malay States,
Singapore.

REPORT from the Institute for Medical Research for the period from April 1st to September 30th, 1909.

Beri-beri.

The researches concerning the etiology of this disease have occupied the most of our time and attention.

Previous observations having shown that there existed a close connexion between the consumption of white rice and beri-beri, rices known to have been associated with outbreaks of that disease were subjected to exhaustive chemical analyses.

Up to the time of writing these analyses have not yielded any satisfactory explanation of the relationship between the consumption of white rice and beri-beri on a poison hypothesis, but they have been suggestive of an explanation on a nutritive hypothesis; the investigation is still far from complete, and it is, therefore, impossible to do more than indicate the trend of our researches.

No suitable opportunity having occurred to repeat the observations made on

two parties of labourers in 1907-1908, it is proposed to carry out experiments on anthropoids. Considerable difficulty has been experienced in obtaining a sufficient number of these animals; experiments with domestic fowls were, therefore, initiated. Primarily intended as a subsidiary experiment until a sufficient number of anthropoids could be collected, results of such an interesting character were obtained that the experiments were extended and elaborated so that they have bulked very largely in our researches during the past six months.

The first experiment was designed to determine whether fowls were sensitive to a difference between Siam and parboiled rices. The fowls were confined, and, apart from the rices, which were given to them cooked along with a supply of drinking water, no other article of food was given. The results showed that fowls are sensitive to a difference between cooked Siam and cooked parboiled rices, as a certain proportion of those fed on Siam rice developed a polyneuritis, whilst those fed on parboiled rices remained healthy.

Experiments were next carried out with fowls fed on cooked Siam rices obtained from the supply consumed by peoples among whom outbreaks of beri-beri had occurred; in each of these experiments a very considerable proportion of the fowls developed polyneuritis. The control fowls, which were fed on cooked parboiled rices, remained healthy.

An experiment in which fowls were fed on freshly milled and cooked Siam rice showed that when fowls were fed on this rice cases of polyneuritis occurred, and the incidence of the disease among these fowls was as great as in the groups of fowls fed on Siam rices known to have been associated with outbreaks of beri-beri. By these and other experiments it was determined that cooked Siam rice, independently of whether it was freshly milled or had been milled several months or more than two years previous to our experiments, independently of whether it was carefully washed previous to cooking, or not washed, was capable of producing polyneuritis in fowls after an interval of three to four weeks, and the incidence of the disease was practically the same in all the groups.

Fowls fed on cooked Rangoon rice did develop polyneuritis, but the incidence of the disease was very low as compared with that in fowls fed on cooked Siam rice, and in a group of fowls fed on freshly prepared and cooked Malay rice, the incidence of the disease was still lower—the evidence obtained showing that considerable differences occur among these rices as estimated by their effect on fowls. Differences have also been shown by chemical analysis.

The Director visited a large rice mill and purchased a bag of partially husked padi, commercially known as “cargo rice.” This material is imported from Saigon, and on the occasion of the visit it chanced that this and not ordinary padi was being milled into white rice. A bag of the rice milled during the visit was also purchased as well as a bag of the polishings. With these materials three experiments were conducted.

- (1) Fowls were fed on the partially husked padi, and all remained healthy.
- (2) Fowls were fed on the white rice, and cases of polyneuritis occurred.
- (3) Fowls were fed on the white rice; in addition each fowl received daily by means of a large soft catheter passed into the stomach an emulsion of polishings, the amount given being that estimated to have been obtained from the quantity of white rice consumed daily by the fowl in question. All the fowls remained healthy.

Experiments have been conducted in which fowls were fed on white and parboiled rices, which had been exhaustively treated with alcohol; suggestive results were obtained, and this line of investigation is being pursued further.

Diets in hospitals, lunatic asylums, and leper asylums.

A Committee, composed of the State Surgeon, Perak, the Senior Medical Officer, Selangor, the Medical Officer in Charge, Negri Sembilan, along with the Director of the Institute, was appointed by the Resident-General to deal with this subject, and the opportunity was taken of having the various articles of food analysed. The results showed in many instances considerable divergence from the analyses quoted in text-books, and on these results the diet scales were elaborated.

The use of parboiled rice was advised in all public institutions because we know that those people who habitually consume parboiled rice do not develop or contract beri-beri.

Parboiled rice as prepared in the local mills has usually an objectionable odour,

and in this connection efforts were made to get the proprietors of a large rice mill to improve the quality of their parboiled rice. These efforts were successful, and it has been shown that a parboiled rice can be prepared in this country free from objectionable odour, and that the increased cost of production is practically nil.

Ankylostomiasis.

An investigation dealing with the incidence of ankylostomes and ankylostomiasis among labourers on estate was commenced during the preceding six months and completed during the six months now under review.

The fæces of a large number of people on different estates were examined, and it has been shown:—

- (1) That the percentage of labourers harbouring ankylostomes is very considerable.
- (2) That in only a small percentage of cases can death be directly attributed to ankylostomes.
- (3) That it is impossible to determine with any degree of accuracy the percentage of labourers suffering from the effects of ankylostomes.
- (4) That persons harbouring ankylostomes and suffering from malaria may show themselves resistant to treatment. In the case of other diseases it is possible that the presence of ankylostomes may retard recovery or lessen the chances of recovery.

In view of the importance of this subject I append a copy of Dr. Stanton's report.

Suggestions have been made to Government with a view to combating this evil in these States as regards—

- (1) The provision of suitable latrine accommodation.
- (2) The provision of adequate and properly protected water supplies.

The second being necessary because the latrines must be near the labourers' quarters, and the accumulation of the excreta in these places increases the risk of contaminating the water supply, which is usually obtained from wells near the quarters.

Pathology, Bacteriology, &c.

A considerable number of routine examinations of pathological material have been carried out, including the diagnosis of tumours, parasites, and ova, agglutination reactions, inoculations for the diagnosis of rabies, &c. The amount of material forwarded by medical and veterinary officers is increasing yearly. Collections of such material likely to be of interest to workers in special subjects in Europe are forwarded to them from time to time. Valuable help has been given by these workers, and in this connection our thanks are especially due to Dr. Leiper, of the Department of Helminthology, London School of Tropical Medicine.

Chemical Department.

So much of Mr. Eaton's time is occupied with routine examinations, medico-legal, &c., that he is unable to devote much attention to research work, but his analyses of foodstuffs were most useful to the Committee on hospital diets, and he has given us great assistance in our chemical investigations of rices.

H. FRASER,
Director, Institute for Medical Research,
Federated Malay States.

ANKYLOSTOMIASIS AMONG TAMIL COOLIES EMPLOYED ON RUBBER ESTATES.

1. To determine the number of persons harbouring ankylostomes relative to the general population, various estates and estate hospitals were visited and systematic observations made.

(a) Estate Hospital in Negri Sembilan.

This hospital is a large one, receiving patients from fourteen estates, and is situated in a district where ankylostomiasis is considered to be widely prevalent.

Examination of fæces of 152 patients taken without reference to the disease for which they were under treatment, gave the following results:—

Ova of ankylostomes alone	...	...	...	...	...	31
Ova of ankylostomes and round worms	...	...	...	...	...	36
Ova of ankylostomes and whip worms	...	...	...	...	...	10
Ova of ankylostomes, round worms, and whip worms	...	...	...	...	...	8
Ova of round worms alone	...	...	...	...	...	30
Ova of whip worms alone	...	...	...	...	...	8
Ova of round worms and whip worms	...	...	...	...	...	8
Ova of round worms and thread worms	...	...	...	...	...	1
No ova found	...	...	...	...	...	20
						152
Percentage of estate hospital patients harbouring ankylostomes	...	...	...	...	...	56

(b) *Rubber Estate in Selangor No. I.*

This place enjoys the reputation of being a "very healthy estate."

Examination of 158 coolies, who, on the day of examination were at work, gave the following results:—

Ova of ankylostomes alone	...	...	...	...	...	18
Ova of ankylostomes and round worms	...	...	...	...	...	17
Ova of ankylostomes and whip worms	...	...	...	...	...	3
Ova of ankylostomes, round worms, and whip worms	...	...	...	...	...	1
Ova of round worms alone	...	...	...	...	...	50
Ova of whip worms alone	...	...	...	...	...	2
Ova of round worms and whip worms	...	...	...	...	...	1
No ova found	...	...	...	...	...	66
						158

Percentage of coolies on "healthy" estate harbouring ankylostomes 25. The infections in all cases on this estate were extremely scanty.

(c) *Rubber Estate in Selangor No. II.*

This place was formerly considered to be a very "unhealthy" one, chiefly on account of the prevalence of malaria. The amount of illness from this disease is now stated to be much less.

Examination of 67 coolies, who, on the day of examination were at work, gave the following results:—

Ova of ankylostomes alone	...	...	...	...	...	9
Ova of ankylostomes and round worms	...	...	...	...	...	24
Ova of ankylostomes and whip worms	...	...	...	...	...	3
Ova of round worms alone	...	...	...	...	...	18
Ova of round worms and whip worms	...	...	...	...	...	2
No ova found	...	...	...	...	...	11
						67

Percentage of coolies harbouring ankylostomes ... 54

(d) *Rubber Estate in Selangor No. III.*

This is an estate recently opened up, and is near No. II. Owing to quinine prophylaxis, the sickness rate has not been a high one.

Examination of 114 coolies, who, on the day of examination were at work, gave the following results:—

Ova of ankylostomes alone	...	...	...	...	...	11
Ova of ankylostomes and round worms	...	...	...	...	...	22
Ova of ankylostomes, round worms, and whip worms	...	...	...	...	...	2
Ova of round worms alone	...	...	...	...	...	23
Ova of whip worms alone	...	...	...	...	...	4
Ova of round worms and whip worms	...	...	...	...	...	5
Ova of round worms, whip worms, and thread worms	...	...	...	...	...	1
No ova found	...	...	...	...	...	46
						114
Percentage of coolies harbouring ankylostomes	...	...	...	...	...	31

In this series of examinations, therefore, there is found sufficient evidence of the widespread nature of the infection, varying from 25 per cent. in the case of coolies on a "healthy" estate to 56 per cent. in the case of patients admitted to an estate hospital.

It will be noted that, except in the case of the estate hospital patients, few of these coolies can properly be said to be suffering from ankylostomiasis. In each infected individual, however, all the potentialities are present for the development of that disease and for the conveyance of the infection to his fellows.

2. The relative distribution of the two species of ankylostomes was determined from the examination of a large number of worms recovered from estate coolies after the administration of anthelmintic drugs, and in the course of post-mortem examinations about two thousand worms were examined.

The so-called "New World" hook-worm (*Necator americanus*) formed about 80 per cent. of the total number. The "Old World" form (*Ankylostome duodenale*) though relatively infrequent in Tamils, is the more common form found in Chinese. Occasionally the two forms are found in the same subject.

3 and 4. The determination of the proportion of Tamil labourers suffering from the effects of ankylostomes, and of the relative importance of ankylostomiasis as a cause of death, presents considerable difficulty. Owing to the frequent existence in this country of other infections, notably malaria and dysentery, in individuals harbouring ankylostomes, the part played by these latter parasites in inducing disease or a fatal result is not easy to estimate. It may, perhaps, be safely inferred from the experiences of workers in countries where malaria and dysentery are practically non-existent that this part is an important one.

With a view to throwing light on this aspect of the question, the blood of a number of coolies in each place was examined for the presence of malaria parasites. The results were as follows:—

(a) *Estate Hospital in Negri Sembilan.*

Number of specimens examined, 133.

Number of specimens examined, 133.				
Parasites of benign tertian malaria alone	...	...	...	15
Parasites of sub-tertian (malignant) malaria alone	..	...	...	16
Parasites of benign tertian and sub-tertian malaria	...	...	...	2
Parasites of quartan malaria	...	...	...	10
				133

Percentage of patients harbouring malaria parasites	...	...	...	...	32
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(b) *Rubber Estate in Selangor No. 1.*

Number of specimens examined, 160.

Parasites of benign tertian malaria	...	...	...	...	2
No parasites found	...	...	...	...	158
					160

Percentage of coolies at work harbouring malaria parasites	...	...	...	...	1
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(c) *Rubber Estate in Selangor No. II.*

Number of specimens examined, 55.

Parasites of benign tertian malaria alone	...	...	...	3
Parasites of sub-tertian malaria alone	...	...	...	14
Parasites of benign tertian and sub-tertian malaria	...	...	...	1
Parasites of quartan malaria	...	...	...	1
No parasites found	...	...	...	36

55

Percentage of coolies at work harbouring malaria parasites 35

(d) *Rubber Estate in Selangor No. III.*

Number of specimens examined, 160.

Parasites of benign tertian malaria alone	...	...	...	9
Parasites of sub-tertian malaria alone	...	...	...	19
Parasites of benign tertian and sub-tertian malaria	...	...	...	2
Parasites of quartan malaria	...	...	...	1
No parasites found	...	...	...	129

160

Percentage of coolies at work harbouring malaria parasites 19

In view of the fact that the coolies on these latter estates (Selangor Nos. II. and III.) are regularly being given quinine as a prophylactic, it is unexpected to find such a large number in whose peripheral blood malaria parasites are to be found. Taken in conjunction with the comparatively high ankylostoma incidence, these observations appear to re-affirm a conclusion reached by an investigator in the southern United States that "the existence of uncinariasis (ankylostomiasis) in an individual who is also the host of malarial parasites apparently has some real influence in causing the malaria to be more persistent than usual in spite of ordinary or earnest antimalarial medication." It has been found that in certain patients suffering from malaria, thorough quinine treatment has proved ineffective. On further examination the presence of a co-existent ankylostoma infection has been determined, and after treatment with anthelmintics, the malaria has yielded readily to ordinary dosage of quinine.

Two hundred and fifty coolies at work on a Negri Sembilan estate where ankylostomiasis was prevalent were examined for evidences of anæmia; about 30 per cent. were found to be suffering from a moderate grade, and about 7 per cent. from an advanced grade of anæmia. How far infections other than ankylostomiasis may have been responsible for this condition cannot with certainty be stated.

In the course of a series of post-mortem examinations, especially undertaken with this point in mind, it was rare to find ankylostomiasis anæmia alone as the cause of death.

5. The conditions governing the spread of ankylostoma infection are well known, and find themselves ideally reproduced on most rubber estates in this country. On a very few of the estates visited praiseworthy efforts had been made to combat the evil by the provision of latrines and suitable water supply with adequate supervision. These measures have been too recently put in force to furnish evidence of improvement in the rate of invaliding and general efficiency of the labourers. This result may, however, be predicted with confidence.

Many estate managers objected that the difficulty of weaning the Tamil cooly from his habit of promiscuous defecation constituted an insuperable barrier to the carrying out of effective preventive measures against ankylostomiasis. As the experiment seems not to have been tried however, it is difficult to find a valid basis for this conclusion.

A. T. STANTON,
Bacteriologist.

No. 9.

PERAK.

SPECIAL APPENDIX TO PERAK ADMINISTRATION REPORT FOR 1908.

MEMORANDUM BY DR. CLARKE, MEDICAL OFFICER, BATU GAJAH, ON THE USE OF PARBOILED RICE FOR BERI-BERI PATIENTS.

(Received in Colonial Office, September 20, 1909.)

In Kampar this rice was first used on the 5th January; in Batu Gajah on the 1st March.

In both institutions the effect was immediate; in the lists given the percentage of deaths for the first month at Kampar is a little misleading; it is for the whole month, but of the 23 deaths 14 took place before the 5th of the month.

I attach lists giving the new admissions for each month, the number of deaths, and the percentage of deaths to total treated during each month for the period that I have been in charge of these two hospitals—that is, from July, 1906, up to the end of 1908.

These figures are for all cases of beri-beri treated; there is no deduction for the cases which died within 48 hours of admission, or for any other purpose. The reduction in the death-rates has been very great, and my impression is that only a short time of this rice is required to render death an improbable event.

At the end of 1907, and at the beginning of 1908, there was an exceptional amount of beri-beri, and with most diseases an increased amount coincides with an increased death-rate; but in this case a reduction of death-rate coincided with an increase in numbers.

The reduction is also shown in the yearly death-rate:—

				Batu Gajah. Per cent.	Kampar. Per cent.
1906...	...	...	...	47·6	26·5
1907...	...	...	...	56·8	42·5
1908...	...	...	...	25·6	14·86

The reduction at Batu Gajah is large, but the figures include the two months before the parboiled rice was given; if the cases discharged before the 1st March and the deaths during the same period be omitted, so as to give the rate during the period of its use, the death-rate becomes 16·1 per cent. or about one-third of that of the previous two years.

But, by deducting the cases which died within 48 hours of admission, the contrast becomes more remarkable. I take the corresponding ten months from March to December of 1906, 1907, and 1908, at Batu Gajah, and the whole of the same years for Kampar:—

				Batu Gajah. Per cent.	Kampar. Per cent.
1906...	...	...	...	44·3	21·8
1907...	...	...	...	50·2	37·58
1908...	...	...	...	11·1	9·45

I take ten months in each year at Batu Gajah because there are only ten months of the use of this rice during 1908, whereas at Kampar it was used for the whole year except the first five days.

The cause of this difference lies in the fact that, in the first two years taken, if a man did not die within 48 hours of admission he had a very fair chance of doing so later on, whereas after this rice was begun if a man did not die within 48 hours of admission he had a very fair chance of not doing so at all; and, as a matter of fact, if another 24 or 48 hours were added for the purpose of excluding the cases which died in this period the difference is still more marked.

Below are the figures showing the death-rate after deducting those who died on or before the 7th day after admission for both hospitals:—

				Batu Gajah. (1st March to the 31st December.) Per cent.	Kampar. (1st January to the 31st December.) Per cent.
1906...	...	...	...	41·8	19·00
1907...	...	...	...	45·7	32·11
1908...	...	...	...	7·8	6·78

This difference lies in the fact that the numbers dying each year within seven days or less are about the same—28, 33, 35.

But the 35 of 1908 is more than half the total deaths, whereas in the other two years 28 is less than one quarter, and 33 is about one-third of the total deaths.

In the Batu Gajah hospital only one case of beri-beri has died during January, 1909, out of 95 cases, and this man was admitted on the 30th December, 1908, and died on the 6th January, 1909.

In the gaol the same thing is, perhaps, even more marked. In 1907 there were eight deaths from beri-beri, but of these six occurred before the 30th March, after which date all with beri-beri symptoms were taken off rice and put on to bread instead; during the rest of the year only two deaths occurred.

In 1908 only one death has occurred from beri-beri, and this took place in February; the whole gaol was put on to parboiled rice on the 25th March, 1908.

I do not know that it is necessary to comment on these figures, they seem to speak for themselves; the beri-beri ward was overcrowded for the simple reason that the cases did not die; the difficulty of breathing, formerly so common and so fatal, has practically disappeared. At present it is quite rarely seen except in new cases; but it occurred suddenly in three cases admitted for other diseases, two being ulcers and one a leper, who were on the ordinary stale rice. It was, as usual, fatal.

These figures are a small addition to the proof of Braddon's contention, though I do not consider that further proof is required.

Dr. Fletcher's observations in the lunatic asylum in Kuala Lumpur were most convincing. Though not accepting the theory at that time (I had not then seen Braddon's book), I could not find a flaw in it.

Dr. Fraser's observations on the Pahang border of Negri Sembilan are equally conclusive, and the experience in the Colony seems to be the same. But treatment in the hospital is not all; prevention is wanted. The number of deaths, the amount of disablement, and the loss of work to the State are enormous.

During the five years, 1902-1906 inclusive, there were 17,010 cases of beri-beri treated in Perak hospitals, and 3,988 deaths.

As Braddon says: "The condition which produced beri-beri renders those exposed to it more prone to other disorders than the healthy," and I think not only that no stale rice should be used in the hospitals, but that it is time that the Government began to consider whether they cannot take steps to eradicate the disease from the State. As a small thing it might be pointed out that this would make a difference of practically one ward per hospital, and certainly reduce the number of admissions by one-tenth, though probably by much more. Out of 27,178 in-patients in 1907, 2,785 were beri-beri; which figures take no notice of those who had some of the poison in them. Braddon says: "The only practical way, therefore, to prevent beri-beri in a community is for the State to prohibit the sale of any rice which is not either freshly made, or which has not been cured by boiling or heating in the husk before stripping it; and, simple as these remedies are, nothing more is wanted, as nothing less will suffice, to banish from the countries which it now infests the blight of beri-beri."

I quite agree with Braddon and cannot see that any other course is possible nor do I think if adopted at once that it would be in any way premature.

J. T. CLARKE, M.R.C.S., Eng.; L.R.C.P., Lond.; D.P.H., Camb.,
Medical Officer, Batu Gajah.

RETURN OF BERI-BERI CASES TREATED AT BATU GAJAH HOSPITAL.

Month.	New admissions.	No. of deaths.	Percentage of deaths to total treated.
July, 1906	10	8	18·6
August "	18	19	38·0
September "	22	12	28·0
October "	28	10	19·2
November "	23	20	35·7
December "	23	20	42·5
January, 1907	16	16	42·1
February "	7	5	17·8
March "	13	8	23·5
April "	6	2	9·5
May "	4	2	10·0
June "	12	5	17·8
July "	21	10	22·2
August "	7	16	—
September "	9	5	17·8
October "	9	10	34·4
November "	41	21	35·5
December "	54	29	33·3
January, 1908	52	34	35·7
February "	48	27	28·5
March "	37	4	4·1
April "	33	7	6·2
May "	38	9	7·3
June "	32	8	6·45
July "	29	5	4·1
August "	27	6	5·8
September "	20	7	7·7
October "	28	4	4·3
November "	59	10	8·1
December "	29	3	0·9

RETURN OF BERI-BERI CASES TREATED AT KAMPAR HOSPITAL.

Month.	New admissions.	No. of deaths.	Percentage of deaths to total treated.
July, 1906	29	12	23·7
August "	47	12	16·43
September "	38	8	10·66
October "	67	13	13·39
November "	37	13	17·10
December "	41	11	16·66
January, 1907	33	20	32·78
February "	10	14	36·84
March "	13	5	16·12
April "	12	6	19·35
May "	12	8	26·66
June "	15	8	26·66
July "	26	10	27·2
August "	12	7	23·33
September "	25	4	10·52
October "	14	10	26·31
November "	56	21	29·16
December "	65	22	22·00
* January, 1908	92	23	16·42
February "	50	10	7·51
March "	40	7	5·79
April "	37	4	3·70
May "	40	4	3·57
June "	32	6	5·66
July "	34	3	3·89
August "	39	5	5·37
September "	47	9	9·47
October "	52	9	8·18
November "	54	5	4·80
December "	54	7	—

* Parboiled rice started, 5-1-08.

APPENDIX VIII.

CIRCULAR TO GOVERNORS TRANSMITTING REPORT OF THE
ADVISORY BOARD FOR 1908.*

SIR,

Downing Street, 11 March, 1909.

I HAVE the honour to transmit to you the accompanying copies of a report† by the Advisory Committee for the Tropical Diseases Research Fund, for the year 1908, which has been presented to both Houses of Parliament.

2. You will observe that the report shows that the work done under the supervision of the Advisory Committee maintains the high character which has hitherto characterised it. I shall be glad to receive, as usual, any observations which the medical officers in the Colony may desire to offer on the subject of the report.

3. The Tropical Diseases Research Fund was constituted in 1904, and most of the Colonial and Protectorate Governments which undertook to give subscriptions towards the fund, limited their subscriptions to a period of five years in the first instance, at the end of which time it was contemplated that the position of the fund should, if necessary, be reconsidered.

4. I accordingly consulted the Advisory Committee at their last meeting in December, 1908, as to whether the work done by means of the fund was of sufficient value to justify my asking for a continuance of the subscription from your Government on the same scale as that originally promised. I am glad to say that the Advisory Committee expressed in the most emphatic manner their opinion that the work done by the fund was of the highest value, and that it would be a calamity if its work were to be restricted by any failure in the contributions received.

5. The fund provides for the salaries of a Lecturer in Economic Entomology and Parasitology, and for a Lecturer in Tropical Medicine at the Liverpool School of Tropical Medicine; and for the salaries of a Teacher and Investigator of Protozoology, a Teacher and Investigator of Helminthology, and an Arthropodologist at the London School of Tropical Medicine.

6. By another grant there has been established a Professorship of Protozoology at the University of London, and the report of the work done by Professor Minchin, included in this year's report of the Committee, will show how valuable this appointment is.

7. At Cambridge a Research Studentship in Medical Entomology has been established on the advice of Professor G. H. F. Nuttall. All these officers are performing valuable and useful work, both in the interests of the public health and of the economic conditions of the tropical Colonies and Protectorates, and I have no doubt that your Government will be anxious to continue its subscription to the fund which enables this work to be done.

8. Moreover, the existence of the fund has brought with it the existence of the Advisory Committee, and not only have the Committee given me the advantage of their expert advice on all matters relating to the distribution of the fund, but they have assisted me in many matters lying outside the immediate scope of the Research Fund itself. I am glad to say that, thanks in no small measure to their advice, the reports received from Colonial laboratories have increased greatly in value, and I have been glad to follow their advice in arranging for the establishment in West Africa of a Central Laboratory, in which valuable experimental work will, I feel confident, be done.

9. I shall therefore be glad if you would be so good as to invite the Legislative Council to vote for five years more a grant of—

[Gold Coast	...	...	...	...	...	£200
Southern Nigeria	...	...	...	...	...	350
Ceylon	...	...	...	...	...	100
Straits	...	...	...	...	...	100
Federated Malay States	...	...	...	...	...	100
Hong Kong	...	...	...	...	...	100

* Paragraph 9 shows the Colonies, &c., to which this despatch was sent.

† [Cd. 4476].

Trinidad	...	...	...	...	...	...	100
Fiji	...	...	...	...	...	...	100
Sierra Leone	...	...	...	...	...	...	100
Gambia	...	...	...	...	...	...	100
British Guiana	...	...	...	...	...	...	100
Grenada	...	...	...	...	...	...	50]

I have, &c.,
CREWE.

TROPICAL DISEASES RESEARCH FUND.

R E P O R T

OF THE

ADVISORY COMMITTEE FOR THE TROPICAL DISEASES RESEARCH FUND

FOR THE YEAR 1910.

(*For Report for 1909, see [Cd. 4999], February, 1910.*)

Presented to Parliament by Command of His Majesty.
February, 1911.



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2	Annual Report on the Medical and Health Department.	Mauritius	(Rec. in Colonial Office, Feb. 26.)	Extract from the Annual Report on the Medical and Health Department for 1908 dealing with malaria.	5
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5	Dr. W. H. Langley	Gold Coast.	October 14	States that he is prepared to advocate further measures in likely cases of the administration of quinine to children, but thinks that more valuable results will accrue from actual mosquito reduction.	12
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REPORT OF THE ADVISORY COMMITTEE FOR THE TROPICAL DISEASES RESEARCH FUND FOR THE YEAR 1910.

The Advisory Committee for the Tropical Diseases Research Fund was constituted by the Secretary of State for the Colonies in July, 1904, and is now composed as follows :—

The Right Honourable Sir J. West Ridgeway, G.C.B., G.C.M.G., K.C.S.I.,
P.C. (Chairman).
Sir Thomas Barlow, Bart., M.D., K.C.V.O.
Colonel Sir David Bruce, C.B., F.R.S.
Sir Thomas Holderness, K.C.S.I.
Sir Charles Lucas, K.C.M.G., C.B.
Sir Patrick Manson, M.D., K.C.M.G., F.R.S.
Dr. J. Rose Bradford, F.R.S.
Surgeon-General A. M. Branfoot, C.I.E., I.M.S.
Mr. H. J. Read, C.M.G.
Major Ronald Ross, C.B., F.R.S.
Mr. J. A. C. Tilley.
Mr. A. Berriedale Keith (Secretary).

The Revenue of the Tropical Diseases Research Fund for the year 1910 was made up as follows :—

Contribution from the Imperial Government	..	...	£1,000
Contribution from the Government of India	...	...	500

Making a total of £1,500

Contributions from Dominion and Colonial Governments
in the following proportions :—

Commonwealth of Australia	...	...	...	£200
Southern Nigeria	...	...	...	350
Gold Coast	...	...	...	200
Ceylon	...	...	...	100
Straits Settlements	...	...	...	100
Federated Malay States	...	...	...	100
Hong Kong	...	...	...	100
Trinidad	...	...	...	100
Fiji	...	...	...	100
Sierra Leone	...	...	...	100
Gambia	...	...	...	100
British Guiana	...	...	...	100
Grenada	...	...	...	50
Leeward Islands	...	...	...	25
St. Vincent	...	...	...	20

Total £1,745

Making in all a total of £3,245

The Expenditure of the year consisted of grants as follows :—

To the London School of Tropical Medicine	...	£2,233	6	8
„ „ Liverpool School of Tropical Medicine	...	1,900	0	0
„ „ University of London	...	750	0	0
„ „ University of Cambridge	...	225	0	0
„ Dr. Sambon	...	150	0	0

Making a total of £5,258 6 8

Of the grant to the London School of Tropical Medicine (£2,233 6s. 8d.), £1,000 was expended in respect of the salaries of a teacher and investigator of protozoology and of a teacher and investigator of helminthology and for the maintenance of the laboratories. The sum of £333 6s. 8d. was expended on the salary of an arthropodologist and expenditure in connection with his laboratory. These teachers are required, as a condition of the grants which are paid to them from the Fund, to

devote a portion of their time to research. The sum of £900 was granted to the School to defray expenses in connection with the sending of an expedition under the Protozoologist to Bagdad for the purpose of investigating the connection between Oriental sore and Kala-Azar.

Of the grant to the Liverpool School of Tropical Medicine (£1,900), the sum of £1,000 was expended partly in payment of the salaries of the lecturers in economic entomology and parasitology and the lecturer in tropical medicine; partly in paying a portion of the salaries of workers in trypanosomiasis and expenses connected with research into that subject. The sum of £900 was granted for the purposes of carrying on the following specific researches, namely :—

- £150 for a chemist, whose time would be devoted solely to research work;
- £250 for a student to perform research work for one year in malaria;
- £150 for a polyglot clerk to work up the bibliography of malaria for the last ten years;
- £250 for carrying out investigation into certain points connected with amœbic dysentery, &c.;
- £100 to enable Mr. Newstead to visit Malta and investigate sandflies.

The grant to the University of London (£750) was expended in paying the salary of the Professor of Protozoology, whose post was established in 1906 by means of a grant from the Fund.

Of the grant to the University of Cambridge (£225), £100 was paid in respect of the research studentship in medical entomology established in 1907 by means of a grant from the Fund, while £100 was granted on the application of Professor G. H. F. Nuttall in respect of the general expenses of the Quick Laboratory, and a sum of £25 was granted towards the cost of erecting a field laboratory in the vicinity of Cambridge. These grants were made, as in 1909, in recognition of the great assistance afforded by Professor Nuttall and the Quick Laboratory to workers from the Colonies.

The grant (£150) made to Dr. Sambon was made on the recommendation of the Pellagra Investigation Committee in order to permit of his proceeding to Italy to carry out investigations into the question of pellagra.

As in 1908 and 1909 no grant was made to the Royal Society from the Fund, since it was found possible to provide from the funds of the Uganda Protectorate the sums required for the continuation of the researches into sleeping sickness which have been carried on under the supervision of the Society.

As the annual income of the grant was insufficient to meet the amount for the year, it was necessary to draw upon the accumulated balance, and the Committee feel that it is of great importance that the sums at their disposal should be largely increased in view of the many questions which urgently require further research.

The Committee have noted with interest the steps taken to combat malaria in tropical Colonies, and they desire to refer to the valuable summary of the question and of the means of prevention contained in Professor Ronald Ross's work on the prevention of malaria published in 1910.

Professor Ross, at their request, has drawn up certain suggestions as to further information which it is desirable to obtain from the tropical Colonies and Protectorates with regard to mosquito-borne diseases, and a circular despatch has been addressed to the Governors of these Colonies and Protectorates, inviting them to furnish the information required in as far as it may be found possible. This despatch is printed as an Appendix to the Report, and there are also printed, as in previous years, the reports of anti-malarial measures taken in the different Colonies and Protectorates.

The Committee also append the reports of the work done at the London and Liverpool Schools of Tropical Medicine for the year November, 1909, to October, 1910; the report of the Professor of Protozoology at the University of London for the session ended June, 1910; the report of Professor Nuttall on the work done by the research student in entomology at the University of Cambridge and in the Quick Laboratory; and reports on the work done at various Colonial laboratories, which have been sent in accordance with requests made by the Secretary of State for the Colonies in December, 1906, and December, 1910. They desire to call attention to the satisfactory character of the work done in these laboratories. The Committee also append a report by Dr. Breinl, the Director of the Australian Institute of Tropical Medicine, Townsville, on the results of his journey to the northern ports of Queensland. A grant of £400 was made from the fund in 1908 towards the establishment

of that Institute, and the Committee trust that much profit to the Commonwealth may result from its labours.

There is also reprinted, with the consent of the Government of Siam, a report of the local sanitary authority at Bangkok with regard to beri-beri, which is of special importance as tending to confirm the important researches of Drs. Braddon and Fraser with regard to that disease, which have been published in previous reports of the Advisory Committee.

WEST RIDGEWAY,
Chairman.

A. BERRIEDALE KEITH,
Secretary.

February, 1911.

APPENDIX I.

Reports on Anti-Malarial Measures in the Colonies.

No. 1.

CEYLON.

REPORT ON MALARIA FOR 1909.

The actual amount of malaria existing during 1909 may be gauged by the number of persons suffering from that disease who attended Government medical institutions for treatment. These institutions may be divided into two classes, the outdoor dispensary and the hospital. At the outdoor dispensaries 501,738 cases were treated, as against 502,307 in 1908; at the hospitals there were 11,117, as against 11,492 in 1908. The total numbers treated in dispensaries and hospitals were 512,855 in 1909 and 513,799 in 1908. The deaths from malaria in hospitals numbered 612 in 1909, as against 718 in 1908. There is no record of the numbers who died while under treatment at the outdoor dispensaries. The malarial cases treated in the jail hospitals and dispensaries are not included in the above figures.

2. The measures taken to eradicate malarial fever in 1909 were similar to those employed during the previous year, viz., (a) education, (b) improved sanitation, (c) quinine prophylaxis.

Under (a) the Provincial Surgeons when on inspection tours, the medical officers in charge of hospitals, and apothecaries in charge of dispensaries gave simple lectures on the cause and prevention of malaria to the villagers. Thirty-seven school teachers attended a course of sanitary instruction with special reference to malaria at the Medical College, Colombo. Four of the teachers were unable to complete the course; of the remainder, all but one obtained over 50 per cent. of marks in the examination held at the conclusion of the course. A simple syllabus on sanitation has been drawn up for the use of pupils in grant-in-aid vernacular training schools.

There was a wide distribution of pamphlets in the vernacular languages, setting forth in a simple manner the cause of malaria and its prevention.

3. Improvement in the general sanitation of small towns has been noticed during 1909: surface drains have been introduced into places where there was no drainage previously and extension of existing drains in others, brushwood has been cut down in the neighbourhood of dwellings, hollows have been filled up, and pools of water drained, but no large works for the destruction of the malarial mosquito have been undertaken. I regret that the suggestion for the formation of "mosquito brigades" has not been followed.

It may be said that the attitude shown by the large majority of the people towards malaria is one of apathy; on the part of local authorities it is to a great extent due to want of money to carry out the necessary propaganda for the extermination of the anophelinæ. In my opinion some legislative enactment is necessary to compel municipalities, local boards, and the general public to carry out the ordinary simple means by which the eradication of malaria may be accomplished.

All Government hospitals in malarial districts are being provided with mosquito-proof wards for the reception of malarial fever patients.

4. The principal means in use in this Colony for the reduction of malaria is by the distribution of free quinine. This has had a marked effect in reducing the amount of this disease, particularly in the jails and schools; in other words, where it is given to people under discipline. The Manager of the C. M. S. Schools writes: "I have just returned from a tour round our schools, and though I could not in all cases get a report showing names of patients and dates when quinine was given with results of treatment, yet I did get these figures in one or two schools, and I am perfectly satisfied that the results of administering quinine regularly are not only beneficial, but acknowledged to be so by the people, so that they actually ask for the medicine. At one place in the jungle the attendance for the week preceding my visit was 81.2 per cent. of the possible total, which is splendid for this season. The teacher affirmed that had not quinine been administered regularly these results would have been impossible at this time of the year."

5. We have not tried here the effect on malaria of the introduction into large collections of water of small fish which destroy the mosquito larvæ. Serious outbreaks of malaria in dry years have been noticed frequently in this country, and a

probable reason for these outbreaks is the destruction of fish during droughts, as suggested by Lieutenant-Colonel J. Chaytor-White, I.M.S.; at the Imperial Malaria Conference at Simla last year.

6. The total amount of quinine issued from the Civil Medical Stores was 76,679 ounces, which cost Rs. 42,273.45.

7. As in the previous year, a "spleen census" was taken towards the end of 1909. The estimated population of children under fifteen years of age was 1,633,711; in 1908 this population was estimated at 1,622,766. This year 317,694 persons were examined, and enlargement of the spleen was found in 66,141, as against 92,258 persons and 31,421 enlargements found in the 1908 census. The spleen rate this year was 20.81 and the average spleen 1.75; last year the spleen rate was 34.05 and the average spleen 2.29.

The following table gives in detail the number of people examined, the spleen enlargements, average spleen, and spleen rate by Provinces, and corroborates our constant experience in practice as to which Provinces are the most malarious:—

Province.	Number Examined.	No Enlarge-ment.	Total Enlarge-ment.	Enlargement of Spleen.			Spleen Rate.	Average Spleen.
				Small.	Medium.	Great.		
Western	72,571	65,376	7,195	5,597	1,302	296	9.91	1.27
Central	43,263	38,768	4,495	2,786	1,199	510	10.38	1.36
Northern	34,646	24,330	10,316	6,231	2,657	1,428	29.77	2.07
Southern	57,534	52,232	5,302	2,451	1,786	1,065	9.21	1.38
Eastern	12,435	8,971	3,464	2,085	882	497	27.85	2.00
North-Western ...	39,001	20,719	18,282	10,611	5,690	1,981	46.87	2.67
North-Central ...	12,976	4,966	8,010	4,085	2,345	1,580	61.72	3.50
Uva	16,657	10,803	5,854	3,156	1,856	842	35.14	2.34
Sabaragamuwa ...	28,611	25,388	3,223	1,753	797	673	11.26	1.45
Total	317,694	251,553	66,141	38,755	18,514	8,872	20.81	1.75

ALLAN PERRY, M.D.

May 26, 1910.

No. 2.

MAURITIUS.

ANNUAL REPORT ON THE MEDICAL AND HEALTH DEPARTMENT FOR 1908.

(Received in Colonial Office, 26 February, 1910.)

(Extract.)

V.—MALARIA.

As stated in Chapter IV., the Colony has suffered from a widespread and rather severe visitation of this disease during the year under reference. For the first time for many years the number of admissions in the hospitals did not show the usual alternance noted in previous reports as shown in the following tabular statement:—

Years.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
Admissions	4,152	2,848	4,182	3,360	4,788	3,039	5,123	3,674	4,272	5,071

The admissions (5,071) were the largest recorded during the past ten years with one exception and nearly equalled those of 1905, which reached 5,123. This is no doubt to be explained by the heavy rains of the earlier and hotter months of the year, the higher average temperature and higher degree of humidity, but much of this unfortunate state of things was, however, probably also brought about by the financial stringency which was such a marked feature in the history of the Island. A further argument in support of this view is to be found in the increased number of cases of splenic enlargement due apparently entirely to chronic malaria that claimed admission. These cases were probably due to old standing infection, and would under other circumstances not have come to hospital at all.

Allowing for this, the year under review must still, I think, be regarded as a bad one in respect to malaria. - On comparing the figures for the year with those given by Professor Ross for the period 1900-06, it is found that the death-rate from that cause rose from 14·0 to 15·5 per mille of the population, and that the ratio of malarial deaths to total deaths was 38·6 per cent. against 31·0 per cent. Similarly the number of cases of malaria treated at the hospitals and dispensaries in 1908 reached 30,458, against 28,294 in the preceding year.

Every effort was made that could be made with the means at the disposal of the Department to cope with the requirements of the situation.

The following major works were carried out during the year :—

- (a) The drainage works at Clairfond, Phoenix, were completed. The total amount spent on these works has been Rs. 27,897, of which Rs. 14,660·58 were derived from the funds contributed by the War Department.
- (b) A large extent of wooded and swampy ground at Mon Plaisir was reclaimed and dried by the construction of 950 feet of drains, which were connected with those already constructed, thus terminating the important works undertaken in that area.
- (c) Pamplémousses river along a portion of its course through the village of the same name was canalised and its banks roughtrained.

In June, 1908, the Council of Government voted Rs. 5,500 for certain anti-malarial works to be undertaken during the financial year 1908-09, part of which sum was spent on the works mentioned at (b) and (c).

By prison labour and with the funds voted for minor sanitary works, the rivers of Curepipe, Vacoas, Phoenix, Rose Hill, Centre of Flacq and the streams in the extra-urban portion of Port Louis were cleaned and in part canalised. A large area of waste lands in the town of Port Louis itself, the owners of which could not be discovered, was cleared of bush and excavations in them were filled up or drained. With the consent and under the supervision of the Woods and Forests Department the banks of the water-courses above-mentioned were cleared of excess of vegetation and graded.

Important drainage works were commenced at La Louise, Quatre Bornes, by cutting trenches for the drainage of extensive marshes in the neighbourhood of that town.

Professor Ross's visit to this Colony came to an end on February 25th, 1908, but the mosquito-brigade work which had been initiated meanwhile was continued under the supervision of Mr. d'Emmerez de Charmoy, with ten "moustiquiers" and a number of labourers at a cost of Rs. 7,898·10. Much good work was done by these gangs in looking for and destroying mosquito breeding places, but owing to their small number as compared with the extent of country to be covered, their action, which has been confined practically to some of the more populous areas only, could exercise but little influence over the general incidence of the disease. They will, however, prove very useful as a trained nucleus for a more comprehensive organisation when Prof. Ross's recommendations are carried into effect.

Every effort was made to maintain the drainage channels at Clairfond in the highest state of efficiency, and although anopheles mosquitoes were still to be found in small numbers in the locality, there was no indication at the close of the year of any return among the civil population of the epidemic which had prevailed with such intensity during the previous malarial season.

The works undertaken during the year are tabulated in Annexure V.*

Quinine was distributed free from 35 dépôts established in the more malarious localities and from the public dispensaries. Arrangements were also made to permit of Government servants receiving salary at the rate of Rs. 720 and under being supplied with the drug free of charge from the hospital and dispensaries. The total quantity of the drug issued from the Medical Stores during the year was 414 lbs. 15 oz. 39 grs., worth Rs. 5,055·26.

Professor Ross's report having been received, copies were presented to the members of the Council of Government, the municipal bodies, and persons likely to take an active interest in the subject, and steps were taken to carry out such of the malarial expert's recommendations as were within the means at the disposal of this Department. Two moustiquiers were specially told off for work in Port Louis

* Not printed.

district, and the number of malaria gangs suggested by Professor Ross for the extra-urban portion of the district, of which the Department has sanitary charge, were organised with the labourers already employed by the Sanitary Branch. Rs. 400 having been allowed by Government for the purchase of spleen census registers, preparations were being made at the close of the year, with the kind assistance of the Immigration and Education Departments, for :—

- (a) The periodical examination and quinine treatment of children in schools and on estates.
- (b) The continuous treatment of fever patients on the latter.
- (c) A house-to-house spleen census at Port Louis and the distribution of quinine to the occupants.

No. 3.

SEYCHELLES.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 30 March, 1910.)

MY LORD,

Government House, Seychelles, 9th March, 1910.

I HAVE the honour to report an outbreak of beri beri on the island of Coetivy.

2. Coetivy is an island situated 150 miles to the south of Mahé. It is seven miles long, one and a half miles wide, and rather indifferently planted with coconuts. It is the property of the family Dauban, and is advertised for sale on the 17th instant under proceedings regarding the succession to the estate, and will probably change ownership. Its normal population is about 100 persons, including women and children. The reports of the visiting magistrates over a series of years show that the health of the island has been excellent, and that most of the labour was permanently settled on the island, and included persons of advanced age. No case of beri beri has occurred previously. The settlement is admirably planned and spotlessly clean.

The island is in regular communication with Mahé by means of the "Swallow," a well found sailing ship belonging to the proprietors; a circular trip is made monthly between Coetivy, Barbarons (a large estate in Mahé itself), the island of Silhouette—the properties of the family Dauban—and Port Victoria.

3. Coetivy was inspected by the visiting magistrates on March 17th and 18th, and November 20th and 21st, in 1909. On the latter occasion complaint was made as to the quantity of the coconut oil served out for rations, but it was proved that the quantity was strictly correct.

4. On February 24th, on the arrival of the "Swallow," the Manager of the island, who was himself ill, reported an outbreak of beri beri between the 1st and 18th of February in which 25 cases had occurred and 13 deaths had ensued. Eight patients were brought back by the "Swallow," of whom six were lodged in hospital; one of these died, but that particular case was complicated by other ailments. Three of the others have been discharged as recovered, and two cases remain in hospital, but may now be pronounced convalescent.

It is characteristic of this disease that all the cases, except that which ended fatally, began to mend on removal from the locality of the outbreak.

The symptoms in this outbreak indicate clearly the typical signs of beri beri much more so than those which had occurred in past years from Flat Island, Marie Louise, or St. Pierre.

5. The notes by Dr. Addison, Chief Medical Officer, which are annexed set out particulars of the cases and of the local conditions which point to the cause of the outbreak. It seems fairly well established that this outbreak is due to nitrogen starvation setting up a disease affecting the nerve system: The operating cause was the deprivation of the meat diet to which the men were accustomed, the loss of which lowered the tone of the men who became weakened and dispirited. The immediate cause was an excessive rainfall and continued saturation.

It is worth explaining that the rice, which is always described as "Saigon," really came from Rangoon, and is a Burmah rice.

6. The restriction of the men's privileges of obtaining fresh turtle, pork, and fish was due to the ignorance of local conditions by one of the heirs of the estate—Mr. Gaston Dauban—who, newly arrived on a visit from France, gave the orders

which operated from August last. These orders involve no transgression of the law regarding the food scale laid down for labourers on outlying islands, but all managers with local experience encourage the men to supplement their diet with meat rations which cost the estate nothing to provide.

7. On receipt of the information on the 24th ultimo I arranged for the despatch of the visiting magistrate (and assistant medical officer) to Coetivy. As the "Swallow" is a slow sailer, and the period of calms had set in, I chartered—in concert with Mr. E. Dauban (the responsible owner)—a small vessel with motor power which made the journey in 30 hours. Dr. Power reports that no new cases had occurred on the island, and that two patients left there on the 19th ultimo had now recovered.

8. I annex copy of the orders given by Dr. Power which should ensure the good health of the population of Coetivy for the future.

9. I propose to amend the scale of rations for the outlying islands as fixed by law by requiring that a ration of lentils shall be served out to any person demanding lentils in lieu of salt fish. Circular instructions to that effect are meanwhile issued.

I have, &c.,

W. E. DAVIDSON,
Governor.

Enclosure 1 in No. 3.

INFORMATION concerning the outbreak of Beri Beri at Coetivy Island obtained from Captain Hoareau, the Manager of the Island, and from the men in hospital at Mahé, and remarks thereon.

The Cases.

During the month of December three men fell sick on the island and were sent to Mahé; they were all swollen, and one of them was subsequently paralysed. Of these three men two came to the Victoria Hospital, one of them died the day following admission, and was considered to be a case of chronic heart disease; the other, the paralysed man, was a perfectly typical case of dry beri beri, he remained in hospital for about 14 days, and was then discharged at his own request, his condition not having ameliorated. Of the third man nothing is known.

On December 25th a child, aged about 7 months, died on the island, from the description given the case was one of beri beri.

On January 16th an Indian woman died from the disease.

On January 28th the Manager's child of 18 months died, but it is doubtful if this was a case of beri beri.

Between February 1st and February 18th 11 persons died, they had all been swollen, and complained of pains in their legs and stomachs accompanied by weakness of the limbs. Vomiting was a prominent symptom in all the cases, death was always preceded by suffocation.

There were altogether about 25 cases, eight of these came to Mahé and six were admitted to the Victoria Hospital, all of these are undoubtedly suffering from beri beri.

The Manager made certain observations on the cases:—

- (1) That purgatives did great good.
 - (2) That alcohol seemed to do harm.
 - (3) That the cases in which the vomiting was the first symptom did better than those in which the vomiting was secondary to the swelling.
- He states that cases in which this was the sequence of events all died.

Local Conditions.

At the end of December, and in the early days of January, the weather was extraordinarily damp. Rain fell in enormous quantities, and for eight days the island was enveloped in fog; the Manager states that in spite of his considerable experience in island conditions, he has never seen anything so damp—everything became mouldy.

Previously to the month of August, 1909, it was the custom to give out as food to the labourers all turtle that could be caught, this meant that during about six months of the year the average number of turtle was about two per month.

Also, it was permitted to rear pigs, and these were killed for food, the average being about two pigs a month all the year round.

Oil was milled on the property.

In August, 1909, orders were given that no turtles were to be killed on the island, but that all that could be obtained were to be sent to Mahé. The Manager was allowed one turtle every two months, but was forbidden to supply any to the men; at the same time the rearing of pigs was absolutely forbidden, and oil was no longer made on the island, but was sent from Mahé. The men complain bitterly that this oil was rancid, and was unfit for cooking purposes, and rather than use it they preferred to pay six cents apiece for coconuts to use in cooking.

During the month of December, 1909, orders were sent to the Manager of the island to forbid the men to use casiers to catch fish, and the men were also forbidden to sell fish to their fellow labourers, any fish they could not themselves consume were to be sold to the proprietor; the idea of this apparently being to ensure a plentiful supply of fish to be salted and served out to the labourers as rations, and thus to get over the necessity of supplying lentils, the amount of which, under the New Ordinance, has lately been increased to three lbs. per week.

In former days the men were given two coconuts each per week, but lately this custom was abandoned, and if the men wanted nuts they had to pay six cents each for them.

The men were allowed to keep a few fowls.

Occupation had no effect on the disease, the labourers picking up nuts being equally affected with those who were cleaning the property, or were otherwise engaged, nor were the cases confined to one part of the island.

No new work, *e.g.*, turning up the soil, &c., had lately been undertaken.

Remarks on the Epidemic.

This epidemic is of the greatest importance and interest from the point of view of the causation of the disease. As Your Excellency is well aware, the two chief theories as to the causation of the disease are (1) poisoning by the use of the rice known as Saigon; and (2) nitrogen starvation. Experiments lately made and reported on in the Malay States have proved, I think, conclusively, that in that part of the world Saigon rice is the real cause, but this does not seem to be so in Seychelles. This rice is largely consumed by the population of Mahé, much more so than Bengal rice, and yet beri beri is almost unknown in Mahé. To the best of my belief there has been no case for the last five years although there have been cases in the islands more or less continuously during this period.

The present outbreak seems strongly to point to the fact that nitrogen starvation is the cause of beri beri as it occurs in Seychelles. I have already given this as my opinion in a report I wrote on the disease some three years ago, and Coetivy confirms it. Here we have an island on which there have never been cases of beri beri previously, and where the men were comparatively well fed, that is to say, they got fresh flesh food regularly, and plenty of fresh fish; orders were given some six months ago which entirely did away with the flesh food, the only flesh that the men could get would be that of any fowls they might rear for themselves, and I think it unlikely that they would have eaten a fowl more than once a month; and more recently orders have been given which diminished the men's chances of getting fresh fish very considerably. Their diet, therefore, has consisted only of rice, salt fish, and such green vegetables, *e.g.*, pumpkins and "langue de bœuf," as they could gather; this diet almost entirely lacks nitrogen, of which only a small amount would be obtained in the salt fish, and on this diet beri beri has declared itself.

I had the honour of being a member of a committee which Your Excellency appointed some time ago to consider the Outlying Island Ordinance, and I strongly advised that the rations of lentils should be increased; this was done, but it seems that the proprietor of Coetivy has got round this by taking measures to ensure a plentiful supply of salt fish, which the Ordinance allows to be given in lieu of the lentil ration, and to do this has diminished the amount of fresh fish that the men can obtain.

In view of this it should, I think, be considered whether the Ordinance should not be amended, and it made compulsory to serve lentil ration.

J. B. ADDISON,
Chief Medical Officer.

Seychelles,

February 26th, 1910.

Enclosure 2 in No. 3.

INSTRUCTIONS to Manager of Coetivy Island given this 2nd day of March, 1910.

1. Turtle to be given to the labourers until further orders, and when plentiful at least twice per month. If scarce, once per month.

2. Upon arrival from Mahé of "red" rice, the issue of Saigon rice to be discontinued until further orders. [Red rice is the local term for Bengal rice.]

3. Lentils to replace as far as possible salted fish as a ration.

4. The sinking of casiers on the reef to be allowed as formerly, any orders to the contrary notwithstanding.

5. Any money paid by the labourers to the property for coconuts bought by them on account of the rancid oil supplied from Mahé to be refunded to them, and the issue of said oil to be discontinued at once.

6. Upon any man or woman showing symptoms of the disease, such as vomiting, swelling of limbs, paralysis, or sign of heart trouble, the Manager will immediately place such man or woman in hospital, administer a purgative as directed, and shall send the sufferer to Mahé at the earliest opportunity.

7. Until further orders as much fresh fish as possible to be given to the men.

8. By each trip of the "Swallow" or other vessel going to Mahé a return of all labourers sick on the island to be sent to the Chief Medical Officer with particulars as far as possible of each case.

Given at Coetivy Island this 2nd day of March, 1910.

MICHAEL S. POWER,
Visiting Magistrate.

Approved:

W. E. D.,
5 March, 1910.

No. 4.

GOLD COAST.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 1 July, 1910.)

MY LORD,

Government House, Accra, 11th June, 1910.

WITH reference to your Lordship's despatch of the 27th August last,* and previous correspondence, on the subject of the prevention of malarial fever among native children, I have the honour to transmit a copy of a minute by the Acting Principal Medical Officer (Dr. Garland), covering two reports by Dr. Eldred, Medical Officer of Health.

2. In stating in his minute that "a drawback in connection with chocolate administration is the fact that the dosage is arbitrary," Dr. Garland apparently overlooks the offer of Messrs. Howards and Sons to prepare the tablets in any shape and containing any quantity of quinine tannate that may be desired; and I would suggest that this correspondence should be referred to Dr. Langley, who is now on leave in England.

I have, &c.,
JOHN RODGER,
Governor.

Enclosure in No. 4.

MINUTE by the Acting Principal Medical Officer (Dr. Garland).

HONOURABLE COLONIAL SECRETARY,

I FORWARD a brief preliminary report on the administration of quinine to a limited number of the school children, and a report on the examination of 600 school children for spleen rate and parasites in blood.

The latter report is a valuable one; the former report shows that the experiment has been conducted on too limited a scale to provide any really useful information even when the results are further reported on.

A drawback in connection with chocolate administration is the fact that the dosage is arbitrary and it does not provide for infants and very young children, where smaller doses are indicated.

I have been in the habit of treating such cases with small doses of quinine with crushed sugar, and if a stock powder of this was kept at the dispensary the natives might readily obtain the necessary doses by simply giving the name and age of the child, and these cases could be then watched and reported on.

The only treatment at present adopted by natives for treating fever in infants or children is the administration of castor oil. I am led to believe that they object to the use of quinine, knowing the care that must be exercised as to the dose.

P. J. G.,
Acting Principal Medical Officer.

28th April, 1910.

SIR, Municipal Offices, Accra, 15th April, 1910.
I HAVE the honour to report as follows on the experimental administration of quinine to school children. Twelve of the youngest boys (about 5 years old) in the Government School were selected.

The parents were asked if they would consent to the giving of quinine to their children. Seven refused to permit. The remaining five children all refused to take quinine in the ordinary preparation.

Quinine made up into chocolate tablets is now being administered to these five, and I understand they show no objection to it in this form.

I will submit a further report on the spleen rate and blood examination (before and after taking quinine) on the cessation of the quinine administration.

I have, &c.,
A. G. ELDRED,
Medical Officer of Health.

The Principal Medical Officer.

SIR, Municipal Offices, Accra, 29th April, 1910.
IN continuation of my letter of 15th instant, I have the honour to report as follows.

As stated, in only five cases could the experiment be carried out, with the following results:—

No.	Spleen.	Parasites.
BEFORE QUININE ADMINISTRATION.		
1	3 inches below costal margin	+
2	+	—
3	+	—
4	2 inches	—
5	2 inches	—
AFTER QUININE ADMINISTRATION.		
1	$\frac{3}{4}$ inch	—
2	—	—
3	—	—
4	$\frac{3}{4}$ inch	—
5	Boy did not appear for examination.	

I have, &c.,
A. G. ELDRED,
Medical Officer of Health.

The Principal Medical Officer.

Municipal Offices, Accra, 28th February, 1910.

RETURN of Examination of 600 Children (Males) during November, 1909, for Malarial Infection.

1. *Spleen Rate*.—28 per cent. shewed enlarged spleen; enlargements varied from perceptible to as much as three or four inches below rib margin.

2. *Blood Infection*.—In only 8 per cent. was a malarial infection found in the blood, examined microscopically.

A. G. ELDRED,
Medical Officer of Health.

No. 5.

GOLD COAST.

DR. W. H. LANGLEY to COLONIAL OFFICE.

(Received 17 October, 1910.)

SIR,

91, Jermyn Street, 14 October, 1910.

WITH reference to your letter of 9th July,* I have the honour to say that, when the subject of quinine prophylaxis against malaria in young children was brought up, as a result of a letter from Professor Osler which appeared in "The Times," I remember that I did not report very enthusiastically as to the possibility of introducing measures into West Africa which might have proved beneficial in Italy; and I drew a comparison between the two countries to enforce my opinion. I also recall having stated that I was more optimistic than Professor Osler seemed to be regarding malaria prevention by mosquito extermination.

2. I have recently been in communication with Dr. Eldred, who conducted the experiment in Accra, and I find he also is by no means sanguine as to the possibility of successfully introducing the scheme.

3. The difficulty as to dispensing an accurate dosage of quinine is one which can easily be met, the paramount difficulty will be the proper administration of the drug.

4. The experiment, so far, demonstrates the value of quinine in reducing "spleen-rates"; but the percentage of malarial parasites found in the blood examined is so small as to quite upset preconceived ideas as to the rate of malarial infection among native children. However, nothing of much value can be derived from a single experiment, and I am prepared to advocate further efforts in likely cases; but my opinion, which has already been placed on record, is that more valuable results will accrue from actual mosquito reduction. Having in view recent experience on the Gold Coast, more thorough measures directed towards general mosquito extermination should take the first place in prophylaxis.

5. Although successful in Italy in averting malarial attacks it remains to be seen whether the effects of quinine on the tender organisations of young children may not ultimately prove baneful. In advancing this proposition I bear in mind the various untoward physiological effects sometimes produced in adults by its prolonged use.

I have, &c.,
W. H. LANGLEY.

No. 6.

WINDWARD ISLANDS (ST. LUCIA).

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 27 January, 1910.)

Grenada, 31st December, 1909.

Forwarded. The course suggested appears to be a wise one, as malaria is prevalent in St. Lucia.

2. I propose that the sum of £100 be entered in the Estimates for next year to meet the anticipated expenditure.

J. HAYES SADLER,
Governor.

* Sending copy of No. 4 for observations.

SIR,

Government House, 10th December, 1909.

I HAVE the honour to report that the Secretary of State's Circular despatch of 31st March last* containing enclosures on the subject of the prevention of malaria, and enquiring as to the extent to which such a policy as is described in those enclosures might be usefully adopted in this Government, was referred by me to the Medical Board of St. Lucia, which consists of the three principal medical officers of the Colony, who, after some unsatisfactory delay, have just sent in to me a report, copy of which I enclose.

2. I also enclose copies of the instructions which have been tentatively drawn up by Dr. Nicholls in case the scheme of prevention is definitely embarked upon.

3. Malaria is very prevalent in St. Lucia, and exercises a vastly prejudicial effect on the labouring class. I am of opinion that such a scheme of prophylaxis as is outlined by the Board, if it can be put into practical working, is likely to be attended with good results and to be well worth the attendant expenditure, which would, from the Board's estimate, be apparently about £100 per annum.

4. I am enquiring from the Crown Agents as to their capacity to supply tannate of quinine comfits suitable for distribution among school children, and at what cost; and should Your Excellency and the Secretary of State see fit to authorise the provision of the requisite funds, and the Legislative Council agree to make such provision, a trial of this policy may be made during the coming financial year.

5. With regard to that part of the report on the proceedings of the Bombay Medical Congress which deals with the subject of snake-bites, I have quite recently made a report to Your Excellency on the subject of the apparent increase of the *fer de lance* serpent in St. Lucia, from the bite of which three deaths have this year taken place. A simple instruction as to the treatment to be followed and likely to be most efficacious in the case of such bite might with advantage be kept at each police station, with a small stock of the proper antidote to be administered. The opinion of some expert in this matter might be usefully obtained. Locally I have been advised by persons of intelligence and experience that the strongest liquor of ammonia is the surest remedy.

I have, &c.,

EDWARD J. CAMERON,
Administrator.

His Excellency

Lieutenant-Colonel

Sir J. Hayes Sadler, K.C.M.G., C.B.,

&c., &c., &c.,

Grenada.

Enclosure 1 in No. 6.

MEDICAL BOARD to ADMINISTRATOR.

HIS HONOUR,

AT a meeting of the Board held this day, all the members and also Dr. Nicholls being present, it was agreed that the gratuitous distribution of quinine throughout the island is advisable as a preventive of malaria. There are about 61 places (police stations, estates, &c.) where stock-bottles could be issued. This would cost about £10 per annum if each of these places were supplied with one Winchester quart of the mixture. (Probably two would be required in some places.) Each Winchester quart should contain:—

Quinine Sulphate	...	...	...	...	1,000 grains
Dilute Sulphuric Acid, sufficient to dissolve...					—
Simple Syrup	...	...	...	...	25 ozs.
Water to make up to	...	...	...	...	100 „

and should be labelled as follows:—

Fever Mixture.

Adult dose	...	...	...	...	one tablespoonful.
From 6 to 12 years	...	...	...	...	two teaspoonfuls.
„ 1 „ 6 „	...	...	...	...	one „
Under 1 year	...	...	...	...	half „

* No. 1 in Appendix I. in [Cd. 4999].

To be given three times a day if required.

Each Winchester quart would cost, with the bottle, about 3s.

The schools throughout the island should be supplied with tabloids or tablets of quinine, each containing two grains, with instructions to the schoolmasters to distribute one tablet weekly to each child and see that it is taken. This would cost per annum £21 per 1,000 school children, or about £62 8s., estimating the school children at 3,000. Thus with the stock mixtures the cost would be about £72 to £82 per annum. The Board think it advisable that samples of quinine sweets with cost be asked for from the Crown Agents, so that they may be tested as to their keeping powers in this climate.

The Board think that the distribution of quinine should be under audit and control.

Leaflets of instructions for schoolmasters and holders of stock-bottles should be prepared, and this Dr. Nicholls has offered to do.

For the Medical Board,
DIGBY M. MACPHAIL,
Chairman.

27 November, 1909.

Enclosure 2 in No. 6.

INSTRUCTIONS.

To Planters and others to whom bottles of quinine are sent.

1. The Government is spending a considerable amount of money in attempting to prevent diseases and promote the health of the inhabitants of St. Lucia. In this matter you are cordially invited to co-operate with them.

2. The great majority of cases of "fever" are suffering from "malarial fever," and quinine has been found by all most competent to judge to be the only drug that will control this scourge. It can be used to act as a "curer" or a "preventer" of "fever."

3. In all cases of "fever" this medicine should be given. In bad cases medical advice should also be quickly sought. The dose, according to age, is on the bottle, and these doses should in bad cases be given every four hours.

4. One dose of this medicine taken every week will, in the majority of people, effectually prevent an attack of fever.

5. One dose of this medicine taken after getting wet would be far more effective than alcohol, which is usually taken to prevent "fever."

6. The distribution of this medicine by employers of labour will undoubtedly find effect in the improved health of the labourers, which must increase the quality and quantity of their work.

Enclosure 3 in No. 6.

To Schoolmasters and Schoolmistresses.

1. The Government is spending a considerable amount of money in attempting to prevent diseases and promote the health of the inhabitants of St. Lucia. In this matter your co-operation is desired.

2. The disease that causes more illness and deaths than any other in this island is what is usually known as "fever." This, in ninety-nine cases out of every hundred, is "malarial fever."

3. It has therefore been decided to distribute small "tablets" to the school children of the island. These "tablets" contain sufficient quinine to prevent "fever."

4. Schoolmasters are therefore informed that they should once in every week give to each child in the school one of these "tablets," and they must see that they are properly taken.

5. Schoolmasters must keep a book and denote with a cross each child that takes the "tablet." In this way he will be able to see that no child is missed.

The book should be kept in the following manner :—

Names of Child.	Date 1st January, 1910.	8th.	15th.	22nd.	29th.
Timothy Jones	X	X	X	X	X
Sarah Slim	X	X	X	X	X
John Jordan	X	X	X	X	X
&c.	X	X	X	X	X

6. A report should be made at the end of each term to the Administrator; the report consisting of the names of the children with the number of tablets taken by each.

Enclosure 4 in No. 6.

To Police Stations.

1. The Government is spending considerable money in attempting to prevent disease and promote the health of the inhabitants of St. Lucia. In this matter you are requested to assist them.

2. Bottles containing a quinine mixture are sent to all police stations. This you are to freely distribute to people who have "fever," or wish to prevent "fever" after they have got wet, &c.

3. This medicine is the only medicine known that quickly arrests "fever."

4. It must be fully understood that in all bad cases of "fever" you must employ your best efforts to persuade the patient to go to, or send for, a doctor. If they cannot immediately obtain medical advice, you must give them this medicine to take every four hours until the doctor arrives.

5. When the medicine is finished the bottle must be returned immediately to be refilled.

No. 7.

WINDWARD ISLANDS (ST. LUCIA).

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 17 May, 1910.)

MY LORD,

St. Lucia, 15th April, 1910.

REFERRING to your Lordship's Circular despatch of the 31st of March, 1909,* and subsequent correspondence relative to the treatment of malaria, I have the honour to transmit copy of a minute by Mr. Cameron enclosing copies of a circular which he has addressed to sixty of the principal residents of St. Lucia soliciting their co-operation in combating malaria in that Colony.

I have, &c.,

J. HAYES SADLER,

Governor.

Enclosure 1 in No. 7.

MR. CAMERON to GOVERNOR.

HIS EXCELLENCY,

REFERRING to the correspondence noted in the margin, I enclose for trans-

Secretary of State, Circular despatch,
31 March, 1909.

Administrator to Governor, 10 Decem-
ber, 1909.

mission, as desired by Your Excellency, copies of a circular I have addressed to some sixty persons in the island—parish priests, estate proprietors, and persons of standing generally in the community—with a view to enlist their services and co-operation in fighting malaria in this Colony.

Copies are also sent for transmission to Grenada and St. Vincent, as asked for by Your Excellency.

E. J. C.

14 April, 1910.

* No. 1 in Appendix I. in [Cd. 4999.]

Enclosure 2 in No. 7.

(Circular.)

(No. .)

SIR,

Government House, 11th March, 1910.

I HAVE the honour to enclose for your perusal two interesting extracts from the London "Times" newspaper on the subject of malaria and the way to fight it.

2. The population of St. Lucia suffer appreciably from this scourge, and the desirability of concerted effort to reduce this suffering to a minimum is very great, the subject being one materially affecting all classes of the community.

3. Provision has been made by the Government for an advance in the anti-malaria campaign in the island during the coming financial year by the free and wide distribution of quinine, and your co-operation in this is cordially invited.

4. A large stock of quinine is now under order, and on its arrival it is intended to supply bottles of quinine mixture, carefully prepared under medical supervision, to all police stations, and to all estates employing labour, where the owner, manager or other person in control is willing to assist by free distribution in accordance with simple directions which will accompany each supply sent.

5. In addition, it is contemplated to make provision for the prophylactic administration of quinine to school children. This administration will be at first in certain selected schools with a view to watching and gauging the effect.

6. Persons will also be engaged (one or two only at first), and kept in permanent employ, and endeavours made to train them to become effective "moustiquiers," according to the plan adopted in the island of Mauritius, to assist generally in this campaign, and particularly in carrying out mosquito-breeding prevention measures of a simple nature to such extent as conditions and funds will permit of.

7. The whole campaign will be under the direction of Dr. L. Nicholls, the Medical Officer of the Anse-la-Raye District, who has been carefully studying the condition of the island in respect to the prevalence of "fever," during the past twelve months and the possibilities in regard to its prevention. Anse-la-Raye has already benefited considerably from Dr. Nicholls's work in it, judging from the diminution of the number of fever cases.

8. Your _____ of _____ has been suggested to me as one of the centres at which bottles of quinine mixture may usefully be kept for distribution as indicated, and I hope to receive a reply from you to this circular, and to learn that you will be willing to undertake such distribution, or to give such directions to your manager or other person in charge of the property as will ensure proper attention being paid to the matter.

9. It is not necessary for me to enlarge on the troubles that "fever" causes in the island. You know them thoroughly. You also know your people and how best to induce them to avail themselves of the means of fighting against it which are now offered.

10. It is not to be expected that the organization of this matter will be perfect all at once, or that some difficulties may not be met with, but if all who are in a position to do so, and to help, will interest themselves in the matter, and use their influence in their immediate surroundings to combat the prejudices of ignorance which may at first militate somewhat against success, I feel sure that a considerable measure of general good to the island may be expected to eventuate.

I have, &c.,

EDWARD J. CAMERON,

Administrator.

No. 8.

SAINT LUCIA.

EXTRACT FROM THE REPORT OF THE MEDICAL OFFICER OF THE
THIRD DISTRICT FOR THE YEAR 1909.

(Received 27 June, 1910.)

PREVENTION OF MALARIA.—In my yearly reports I have always pointed to the swamps that surround Vieux-Fort, east and west. Something has been done to them. The western one in the dry season is almost dry, and as most of all the trees

in it are cut down for the use of the factory this allows of the rays of the sun to play on it and dry it.

The eastern one is also being drained and dried, slowly but surely. Some of the trees in it have been cut, but not to the extent desired or necessary. This should be done so as to allow the rays of the sun, which is a great and unrivalled germ killer, to have fair play, and to penetrate everywhere. Till this is done, this swamp will always be a menace to the inhabitants living to the windward of it, and a breeder of mosquitoes and all kinds of unhealthy miasmata which periodically make themselves felt by their abnormal stench which pervade the air of the whole village.

Mosquitoes of the three species mostly found in this island are not plentiful now-a-days, as the war against them has been pitiless, and has proved too much for them.

The Culicidæ are the most plentiful at present in Vieux-Fort, if plentiful it can be called, where you hardly meet with any now compared with former times.

The Anopheles, or the "barrets" as they are locally called, are very rare; and whereas during the rainy season in former times you used to meet them by battalions, you hardly meet one now, even if you look for them in the swamps.

The Stegomyia is always present in and about the houses of the villages, but in very small quantities now. You never now hear the shrill piping of the vicious Culex, nor feel the sting of the persistent Stegomyia as formerly. You are left in comparative peace now. I grant, to a new arrival from Europe, and unaccustomed to their stings, they sometimes prove annoying, but, from experience, I can assert that not by a fraction as much as was formerly the case.

This is due, in great part, to the efforts of the police, especially of Sergeant Jeffers, who has been a deadly enemy to the mosquito.

The police reported to me weekly about the condition of the villages, both Vieux-Fort and Laborie, and I instructed them as to the disposal of empty tins and broken bottles and stagnant water in the yards of the villages.

The drains of the village streets were seen to, as also the cutting and keeping down the bush in the environs of the villages, and no nuisance allowed to remain long in sight.

The several estates were visited regularly by me, and no nuisance allowed in them.

The reward of these precautions is seen in the gradual, nay, rapid disappearance of the mosquito, and in the better health of the district generally.

No. 9.

WINDWARD ISLANDS (ST. VINCENT).

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 4 April, 1910.)

Grenada, 14th March, 1910.

Submitted. Though not widespread, malaria is prevalent in certain parts of St. Vincent, and in these the experiment might be tried of issuing free some quinine comfits as proposed by the Administrator. The results will show us how far it will be desirable to extend the experiment.

J. HAYES SADLER,
Governor.

SIR,

Government House, St. Vincent, 9th March, 1910.

I HAVE the honour to acknowledge the receipt of the Secretary of State's circular despatch of the 31st March, 1909, relative to "Malaria in Italy: A Lesson in Practical Hygiene," and in reply to forward the accompanying copies of minutes by the late Dr. C. W. Branch and Dr. C. H. Durrant, giving their views as to the possibility of effectively introducing into this Colony the policy advocated by Dr. Osler of free distribution of quinine in malarial centres.

2. In these reports, which go beyond the information called for, Your Excellency will observe that some doubt is expressed as to whether the negro labouring

class can be induced to take advantage of the prophylactic even if provided free, and I share that doubt. The taking of quinine as a prophylactic has a hunger-producing effect which it is not always in the interest of the labourer to cultivate. This he has learned from former attempts which have been made in the same direction, and it will be difficult to set at rest the conflict in his mind as to the balance of good and evil. There are here, from the medical point of view, so many other necessities for which funds are not available that I hesitate to advocate the expenditure of money on what may be regarded as a somewhat hopeless cause. I should like to see, however, whether quinine would be more acceptable to these people in the form of comfits and chocolates as suggested by Dr. Osler in his letter to "The Times," and with that object the Crown Agents might be instructed to obtain, say, £10 worth for purpose of trial in two or three villages where malaria is most prevalent. I would add, though, that this Colony is comparatively free of malaria.

I regret the delay which has occurred in replying to his Lordship's despatch.

I have, &c.,
C. GIDEON MURRAY,
Administrator.

His Excellency

Lieutenant-Colonel Sir James Hayes Sadler, K.C.M.G., C.B.,
&c., &c., &c.,
Governor of the Windward Islands.

Enclosure 1 in No. 9.

Dr. BRANCH to ADMINISTRATOR.

HIS HONOUR,

THE question appears to be

"To what extent can the gratuitous distribution of quinine by the Government be adopted in St. Vincent."

But this question far from covers the ground of quinine prophylaxis. Obviously the people have to be taught to swallow the quinine.

Under the present medical arrangements the Government gives a drug allowance for each medical officer, and he is required to supply necessary medicines *free* to children of labourers under 9, labourers over 60, and to poor persons.

This covers the gratuitous distribution of quinine required for actual illness, but cannot, of course, include the prophylactic use of quinine. It will be easy enough to vote more money for quinine in the form of powders of sulphate for adults and chocolates for children. At the beginning a very modest amount will be called for.

But a very great deal of work must be spent over several years in teaching the people the prophylaxis of malaria before we achieve any wide success.

The medical officers, clergymen, schoolmasters, police constables, headmen of villages and employers of labour must all be enlisted in the work of education.

Practically the scheme will embrace only a part of the island, and at first efforts should be directed to a few selected villages notorious for malaria.

Systematic malarial surveys of such villages must be undertaken, involving considerable microscopic labour on the part of medical officers. Some effort must be directed to sanitation and elimination of breeding places of *Cellia argyrotarsis*.

There is necessarily a great deal of detail which it is easier to mentally anticipate than to express off hand.

But the first requisite is more medical officers and microscopes.

In brief my opinion is that the providing of free quinine will have no result by itself. The more important, difficult, and prolonged part of any scheme for the diminution of malaria is the education of the masses in the use of quinine. With your knowledge of our West Indian negro labourer and his conditions of life, you will readily appreciate the time and labour necessary to bring about any practical result in this matter.

Still I think something can be done by way of a modest beginning in a few villages.

C. W. B.

8 May, 1909.

Enclosure 2 in No. 9.

Dr. DURRANT to ADMINISTRATOR.

HIS HONOUR,

Dr. BRANCH has, I think, dealt fully with the main points in connection with "quinine prophylaxis."

Attempts could be made with notoriously malarial districts, *e.g.*, Cumberland, Clare Valley, &c., to begin with, and at the end of given periods reports furnished on the result.

To be able to submit such reports, however, two factors are necessary:—

- (a) The villagers must swallow the quinine systematically.
- (b) The medical officer must by considerable microscopic blood examination estimate the "malarial index" of the village at stated periods.

Granted that the first of these can be effectively carried out—I know from past experience the difficulty that is likely to be encountered, owing to the indifference with which the labourer will take the quinine, even in malarial epidemics which have occurred, for example, at Clare Valley, where quinine has been gratuitously supplied—the necessary armamentarium will have to be supplied to the medical officer to carry on the microscopic work.

C. H. D.

14 May, 1909.

No. 10.

PAPUA.

THE GOVERNOR-GENERAL OF AUSTRALIA to THE SECRETARY OF STATE.

(Received 23 May, 1910.)

Governor-General's Office, Melbourne,

MY LORD,

18th April, 1910.

IN continuation of my despatch dated 21st October, 1909,* relative to malaria, I now have the honour to transmit herewith a copy of a despatch on the subject which has been addressed to the Commonwealth Government by the Lieutenant-Governor of Papua, together with a copy of the memoranda mentioned therein.

I have, &c.,
DUDLEY,
Governor-General.

Enclosure in No. 10.

TERRITORY OF PAPUA.

SIR,

Government House, Port Moresby, 11th March, 1910.

IN reply to your despatch of 4th June, on the subject of malarial fever, I have the honour to forward copies of memoranda on the subject by Dr. Simson and Dr. Goldsmith.

The distribution of free quinine seems unnecessary, as there is no white person so poor that he cannot afford to pay for it. The other suggestions have been carried out.

I have, &c.,
J. H. P. MURRAY,
Lieutenant-Governor.

The Honourable

The Minister of State for External Affairs,
Melbourne.

MEMORANDUM BY DOCTOR SIMSON.

The cost of rendering houses mosquito-proof would, I think, be a bar to this form of protection. White residents can only be warned in this respect to have mosquito nets for themselves and servants.

* No. 30 in Appendix I. in [Cd. 4999].

I think a good deal might be done by quinine prophylaxis. For this to be carried out satisfactorily, it will be necessary for the Government to supply quinine gratis, and a large amount of money will have to be spent. I am only able to get enough quinine for Government officers and a few natives. In countries where quinine prophylaxis is carried out, a large sum is spent annually in the free distribution of quinine.

For this year, 1909, there has been a great deal of malaria amongst white residents, and few have escaped, but there have been no deaths from this cause. Before the next wet season sets in a few places about the port will have to be filled up or drained, and more weeding done, especially about the drains.

In regard to outlying districts, the Chief Medical Officer is so seldom able to travel that he cannot report, but only give advice how to lessen the malaria. For outlying districts and plantations I think the free distribution of quinine might be successful.

Some months ago I examined 262 children in the three neighbouring villages, and found that 92 had enlarged spleens. In spite of this I have seen very few natives die from malaria, and I don't think the mortality from this source is high amongst them.

C. C. SIMSON,
Chief Medical Officer.

26th June, 1909.

STATEMENT BY DOCTOR GOLDSMITH.

If your enquiry refers to white population only, I consider that free quinine, with instructions as to quantities to be taken, method of taking, and time of taking, issued to all Europeans would, if the instructions were properly carried out, result in a diminution of malaria among them. The same would apply to native servants and employees, if the employer could be relied upon to faithfully carry out the instructions.

With regard to native inhabitants of native villages, I consider the measure impracticable.

With regard to Port Moresby itself, I consider a systematic regular clearance of all tins, bottles, and rubbish from the town, with filling up all holes in which water can lie and mosquitoes can breed, to be more practical as an effort to rid the town of malaria. If there is no still water, mosquitoes cannot breed, and so, if all tanks are enclosed in mosquito-proof netting and all other sources of breeding and laying eggs are shut off, the mosquito must die out, and with it an absence of transmission of the malarial germ. With the mosquito absent, it is quite safe to live among malarial people, as it is only transmitted by their means.

F. GOLDSMITH.

9th March, 1910.

No. 11.

THE SECRETARY OF STATE to THE GOVERNORS OF ALL CROWN COLONIES AND PROTECTORATES EXCEPT WEIHAIWEI, BERMUDA, FALKLAND ISLANDS, ST. HELENA, AND THE MEDITERRANEAN COLONIES.

(Circular.)

SIR,

Downing Street, 20th December, 1910.

I HAVE the honour to enclose the accompanying copy of a note which has been prepared by Professor Ronald Ross on the subject of the prevention of mosquito-borne diseases in the tropical Colonies and Protectorates.

2. This note has been prepared by Professor Ross at my request, on the recommendation of the Advisory Committee of the Tropical Diseases Research Fund, and the Committee concur in the views expressed in it.

3. I shall be glad, therefore, if, as far as may be found possible and as far as the exigencies of professional duties allow, the statistics suggested in the draft return accompanying the note can be supplied annually by your Government; but if it is found in any case impossible without undue labour to supply the information required, that fact should simply be stated, as it is not my desire to overload the

medical or other officers in the territory under your Government with the collection of elaborate statistics. I understand, however, that much of the information should already be available, and that the additional information required, if it can be supplied, will be of great value, both as a record of the state of health in the Colony and as affording a basis for further scientific research.

I have, &c.,
L. HARCOURT.

Enclosure in No. 11.

NOTE BY PROFESSOR RONALD ROSS ON THE PREVENTION OF MOSQUITO-BORNE DISEASES IN THE COLONIES: SUGGESTED RETURN.

1. Towards the end of last year the Advisory Committee invited me to furnish them with my remarks on the various reports which have been sent in by the Colonies for some years past on the subject of mosquito-borne diseases, especially malaria. At that time I had just commenced the compilation of a book on the prevention of malaria in which I hoped to collect in one volume accounts of such work done in many parts of the world; and I therefore asked to be allowed to postpone my remarks on local malaria until this was finished and also until I should have time to complete, not a few brief notes, but a detailed exposition on the subject in connection with each individual malarious British possession.

Unfortunately, my book was not finished until near the end of July, and though I have commenced the compilation of the detailed reports referred to, I have not yet had time, in the midst of much other work, to do more than commence them; but I should like to furnish for the next meeting of the Committee a brief note on the subject, especially regarding a draft return which I should like to submit for their consideration.

2. As shown in the Report of the Advisory Committee for 1907,* Lord Elgin asked the Colonies for reports on the prevention of mosquito-borne diseases, and many such reports have been submitted since then. I have, of course, studied them all with care, and my general conclusion regarding them is that the details of the information required have not always been understood—a thing which is scarcely to be wondered at in connection with such a new subject. It may, therefore, be suggested that a special form, containing headings for all such details, may be sent to each colony to be filled in every year. The draft which I enclose is meant merely for consideration, and may require alterations. I will now explain why the various headings are inserted.

3. It seems to me best to approach the prevention of disease, not so much from its humanitarian as from the economical point of view. Disease always causes a large expenditure of money, both to the people of a Colony and directly to the Government, and mosquito-borne disease is especially a source of such expense, owing to its wide and permanent endemicity, both among the populace and among Government servants. In fact, the prevention of disease should be looked upon economically as being a kind of insurance against the useless expenditure caused by such maladies; and a return of the kind proposed should aim at giving figures which will enable us to estimate both the cost of the disease and the cost of the preventive measures. Such a return will, however, have the advantage, not only of being a permanent record on such points, but of indicating many of the steps which may be taken in the line of scientific and methodical prevention.

4. I have therefore endeavoured to include in my proposed draft headings which will deal with all the more important items. Headings 2, 3, 4, and 5 explain themselves. Headings 6 and 7 will enable us to compute the amount of sickness due to the mosquito-borne diseases compared with the total amount of sickness and death. Heading 8 will give information regarding the medical and sanitary staff of the Colony. Heading 9 (schools) will furnish very useful information regarding the sickness amongst children and also regarding the possibility of utilising schools for prophylaxis amongst the scholars. Similar information will be given by heading 10 in connection with estates employing indentured labour. Headings 11 and 12 will supply necessary facts regarding revenue and expenditure

* [Cd. 3992] March, 1908.

of the Colony. Heading 13 will distinguish details regarding the urban population. Headings 14 and 15 are arranged in order to give information regarding the malaria mortality by means of Meldrum's law, according to which the excess of the mortality during the malaria months over the mortality during the healthiest month may be roughly ascribed to this disease. Heading 16 gives the rainfall for the purpose of scrutinising the monthly mortality returns; and heading 17 will furnish detailed information upon the steps which have been taken for prevention.

5. Though I am not yet ready to examine the reports for each malarious Colony, I should like to add one or two notes regarding some of them.

We are much obliged to Sir Allan Perry for his excellent reports for Ceylon during 1907, 1908, and 1909—reports which give a clear picture of the energetic measures being taken there. I note especially the very large estimations of spleen rates. Thus, during 1909 no less than 317,694 children were examined, of which 66,141 were found to be suffering from enlargement of the spleen, showing the immense prevalence of the disease and the cost which it must inflict upon the public at large. I note also the fact that quinine is distributed in the schools, that sanitary instruction is given to school teachers, that pamphlets in the vernacular languages are distributed, that mosquito reduction in small towns is being undertaken, but that mosquito brigades have not yet been established in all of them as suggested by Sir Allan Perry (Advisory Committee's Report for 1909,* page 10). I think, however, that this will only be a question of time, especially as we cannot help observing the interest taken in the matter in Ceylon and also the great expenditure which the disease must entail there.

The report for Mauritius (*ibid* page 12) is not less interesting. Pending the submission of the report of the Royal Commission (1909) the colony has been able to spend only the small sum of Rs. 6,000 per annum on the preventive measures recommended by me, but it has done so very wisely and with results which appear already to be excellent. The measures have included examination of school children and free grant of quinine to them, similar measures on the estates, a house-to-house spleen census at Port Louis with distribution of quinine, minor mosquito-reduction works in many places, and even some major works. Dr. Bolton, the Medical Officer of the Immigration Department, is now in England, and I have asked him to inform me by letter exactly what has been done—a subject of which he is thoroughly cognisant. I enclose his communication,† which I think may be of interest to the Committee. The eradication of malaria at Phoenix is a noteworthy example of what may be done. When I was there in 1907 a severe epidemic of malaria was raging in the neighbourhood and amongst British troops stationed there. Within one month no less than 71 soldiers were attacked. There were five deaths and, so far as I can remember, some 30 soldiers had to be invalided to England at a cost of over £50 each (I believe). The War Office granted £1,000 for the drainage of the marsh at Phoenix; but it will be observed that the invaliding of the soldiers during one month cost them more than the money which they allotted for assisting the local Government as regards prevention. Since then the drainage of the marsh has been followed by practical obliteration of the disease on the spot—though, of course, soldiers occasionally become affected elsewhere. I am glad to see that the Royal Commission recommend that the system indicated in my report, viz.: regular doses of quinine, the use of mosquito-nets, the canalization of streams, and the drainage of swamps, should be carried out as far as the resources of the Colony will permit.

I will reserve remarks upon the reports from the other Colonies until I have had time to study their statistics in full.

RONALD ROSS,

Professor of Tropical Medicine,
University of Liverpool.

8th November, 1910.

Annexure.

(DRAFT) RETURN of Malarial Fever, Blackwater Fever, Yellow Fever, Filariasis, and Dengue during the year from the 1st January to the 31st December (1910).

1. Name of Colony.
2. Total area.

* [Cd. 4999], February, 1910.

† Not printed.

3. Estimated population :—
 - (a) Total.
 - (b) Europeans.
 - (c)
 - (d) Other races.
 - (e)
4. Births during the year :—

Total births.
5. Deaths during the year—
 - (a) Total deaths.
 - (b) Deaths ascribed to fever.
 - (c) Deaths ascribed to blackwater fever
 - (d) Deaths ascribed to yellow fever.
6. Government Hospitals—
 - (a) Number of such hospitals.
 - (b) Totals, during year { admissions.
 { deaths.
 - (c) Malarial fever { admissions.
 { deaths.
 - (d) Blackwater fever { admissions.
 { deaths.
 - (e) Yellow fever { admissions.
 { deaths.
 - (f) Filarial Diseases { admissions.
 { deaths.
 - (g) Dengue { admissions.
 { deaths
7. Government Dispensaries :—
 - (a) Number of such dispensaries.
 - (b) Total attendances during year.
 - (c) Attendances for malaria.
 - (d) Attendances for filarial diseases.
 - (e) Attendances for dengue.
8. Medical Service :—
 - (a) Number of Government Medical Officers.
 - (b) Number of special Health Officers.
 - (c) Number of other registered practitioners.
9. Schools :—
 - (a) Number of Government and State-Aided Schools.
 - (b) Number of scholars registered in these schools.
 - (c) Percentage of daily attendances.
10. Estates employing indentured labour :—
 - (a) Number of such.
 - (b) Number of indentured labourers employed.
 - (c) Number of hospitals and dispensaries on such estates.
 - (d) Total deaths among such labourers.
 - (e) Deaths ascribed to malaria.
 - (f) Total admissions and attendances at hospitals and dispensaries
11. Estimated revenue of Colony :—

Total during year.
12. Estimated expenditure of Colony :—
 - (a) Total during year.
 - (b) Annual medical and sanitary expenditure.
 - (c) Upkeep of Government hospitals and dispensaries.
 - (d) Total salaries and allowances of medical officers.
 - (e) Total annual sanitary expenditure.
13. Towns under Municipalities or Town Councils :—
 - (a) Number of such.
 - (b) Total population.
 - (c) Total revenues.
 - (d) Total medical and sanitary expenditure.

14. Table of deaths by Districts :—

District.	Area.	Popula- tion.	Total Deaths.											
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.

15. Table of deaths in the principal towns :—

Town.	District where situated.	Popula- tion of town.	Total Deaths												
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.

16. Rainfall during the year :—

Where observed.	District.	Rainfall												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
	</													

17. Additional information to be given if possible on the following points :—
- (a) Is there any legislation in force against the breeding of mosquitos in premises? Numbers of notices, convictions, and warnings during the year.
 - (b) Number of children examined for enlarged spleen. Where was this done? Percentage affected. Does Kala-azar exist?
 - (c) Number of persons examined for filarial diseases. Where this was done? Percentage affected.
 - (d) Any large works for surface drainage of towns or reclamation of marshes. Approximate cost.
 - (e) Numbers of men employed in towns and villages for petty anti-mosquito works. Approximate cost.
 - (f) Amount of Government quinine sold or distributed gratis during the year. Agencies employed.
 - (g) Is quinine distributed regularly in the schools?
 - (h) Measures taken against these diseases on estates employing indentured labour.
 - (i) Any steps taken regarding the housing of the poor.
 - (j) Any exceptional increase or decrease of these diseases recently noticed.
 - (k) Any other remarks on the subject.

APPENDIX II.

REPORT OF THE PROFESSOR OF PROTOZOOLOGY, LONDON
UNIVERSITY, FOR THE YEAR ENDING JUNE 30TH, 1910.

I. GENERAL.

During the past year there have been no changes in the personnel of the department, Dr. Woodcock and Miss Muriel Robertson continuing to give me the benefit of their assistance. The building operations at the Lister Institute, to which reference was made in my last report, being now completed, we have moved back into our former laboratories, which have been increased considerably in size, and we have also been given the use of two additional rooms. One of the new rooms has been fitted up as an aquarium-room, with an asphalt floor; the other room has not yet been fitted up, but it is hoped that it will be ready for use by the end of this month (July).

In August, 1909, I spent about three weeks at the Laboratoire Arago, Banyuls-sur-mer, Pyrénées Orientales, France, by kind permission of the Director, Professor G. Pruvot of the Sorbonne. In April of this year I spent about a fortnight at Messrs. Gurneys' Laboratory at Sutton Broad, Norfolk. During the rest of the year covered by this report (with the exception of brief holidays at Christmas, Easter, and Whitsuntide) I have been working at the Lister Institute.

II. SPECIAL.

1. *Research*.—My work during the past year has dealt with a variety of subjects, which may be classified as follows:—

(a) Investigations, in collaboration with Dr. J. D. Thomson, upon the trypanosome of the common rat; (b) investigations, in collaboration with Dr. Woodcock, upon the blood-parasites of the Little Owl and other blood-parasites observed at Rovigno; (c) other investigations.

(a) *Investigations upon Trypanosoma lewisi*. In my last report, for the year 1908-1909 (Cd. 4999, pp. 45, 46), I set forth fully the objects of this research, and the lines upon which Dr. Thomson and myself are conducting the investigations. During the past year we have been occupied with, first, the experimental investigation of the mode of transmission of the parasite by the flea; secondly, the development of the parasite in the flea; and thirdly, the multiplication of the parasite in the blood of the rat.

With regard to the transmission of the parasite by the flea, we have communicated a preliminary report on our results to the Royal Society (No. 7 of the memoirs cited below), in which we have put forward the following conclusions drawn from the results of our experiments:—

- “(1) The rat-flea, *Ceratophyllus fasciatus*, can transmit *Trypanosoma lewisi* from infected to non-infected rats.
- “(2) The transmission takes place by the cyclical method.
- “(3) Transmission by the direct method has not been proved to occur.
- “(4) The incubation-period of the flea, that is to say, the period occupied by the developmental cycle of the trypanosome, has a minimum length of six or seven days, but may be longer.
- “(5) The multiplication-period of the trypanosome in the rat has a length of about 12 days.
- “(6) In the developmental cycle the establishment of the trypanosome in the flea begins with multiplication of *Crithidia*-like forms in the rectum.”

These experiments are being continued with a view to obtaining precise data with regard to certain other problems of the transmission not yet elucidated. At the moment, however, our experiments have received a check, which it is hoped will be merely temporary, owing to a difficulty in obtaining fleas in sufficiently large numbers for carrying out some of the experiments desired. Some of our old breeding-cages have become defective from one cause or another; in one case a cage became overrun with mites, which killed or ousted the fleas and their larvæ. Fresh breeding-cages have been started and are doing well, and we hope soon to have an abundant supply again. In the meantime, we have been carrying on experiments for which only small numbers of fleas are required, such as feeding

fleas once on an infected rat, and dissecting the fleas afterwards at definite intervals of time, in order to observe the changes that the trypanosomes have undergone in the flea at the end of a known period of time.

Since the beginning of the present year we have been engaged chiefly in studying the development of the trypanosome in the flea, and our investigations on this subject are now reaching a stage at which we hope soon to be able to publish a preliminary report on them. The study of the development of the trypanosome may be analysed into two problems, first, the enumeration and accurate description of the many different forms of the parasite found in the flea, secondly, the sequence in time of these different forms, their relationship one to another, and their significance in the life-cycle as a whole. For the first of these problems it is only necessary to dissect fleas that have fed on infected rats, to make preparations of the trypanosomes found in them, and to draw and describe the various forms that occur. Hence, in order to obtain abundant material for this work, we kept an infected breeding-cage, that is to say, a breeding-cage for fleas in which an infected rat was kept continually, so that every time the fleas fed, they took in blood containing trypanosomes. Fleas from this cage were dissected and examined microscopically from time to time, and a large proportion of the fleas were found to contain the parasites in various stages of development. In order to discover the sequence and relationship of the forms found in the fleas, it is necessary to feed fleas on infected rats and examine them at stated intervals in the manner described in the foregoing paragraph. At the time of writing we have obtained, I believe, specimens of all the forms of the trypanosome in the flea, and our attention is now being directed more particularly to the elucidation of their developmental sequence.

These investigations on the development of the trypanosomes in the flea are very laborious and take a great deal of time; the two chief sources of hindrance are the difficulty of getting individual fleas to feed when required, and the fact that in only a small proportion of the fleas do the trypanosomes succeed in establishing themselves. Our experimental results indicate that under favourable circumstances only about 20 per cent. of the fleas fed on infected rats become infective, and in many cases a much smaller percentage. In practice a large number of fleas may be dissected without finding trypanosomes in them. Thus from our notes I find that between the 27th September and the 10th October of last year, we dissected and examined 30 fleas from a batch which had been fed on an infected rat. In each flea all parts of the digestive tract were examined separately but no trypanosomes were found in any case. It was then thought by us that none of these fleas had acquired the infection, and no more were examined from this batch; but on the 29th October, the rat on which these fleas were being fed was found to have become infected, showing that in this batch of fleas there were some which had become infective and therefore must have contained trypanosomes. This example may serve to show that progress in these investigations is necessarily slow, and it is quite impossible to accelerate the pace in any way. In each flea dissected, the proboscis, stomach, intestine, rectum, and salivary glands are extracted and examined each on a separate slide, a task which it is impossible to perform if the operator is in any way hurried or flurried; if trypanosomes are found in any of the organs examined, permanent microscopical preparations must be made of them, a work which is not difficult but takes time; and finally, the preparations when complete must be searched through methodically with high powers of the microscope to find the trypanosomes, and if, as is often the case, the trypanosomes are present only in scanty numbers, finding them in the preparations is the most tedious and time-consuming part of the whole process.

As regards the multiplication of the trypanosome in the rat, we have made a great number of preparations, drawings, and notes in the course of our investigation of this subject; but for the moment we have laid this part of our work aside, in order to concentrate our attention on the development in the flea. The multiplication of the parasite in the rat can be studied at any time, since infected rats can always be obtained without difficulty; but to study the development in the flea requires a combination of favourable circumstances, chief amongst which is the possession of a large stock of fleas.

(b) *Investigations upon material collected at Rovigno.*—In my report for the year 1908-1909 (Cd. 4999, pp. 47-49), I explained fully the objects with which Dr. Woodcock and I visited the Zoological Station at Rovigno, and the lines upon which we worked there. During the past year we have been steadily engaged, so

far as other work permitted, in going over the material collected and the preparations made, during our stay at Rovigno. In his report, which is appended below, Dr. Woodcock describes fully the progress of our joint investigations. We began by working out the material we had collected of blood-parasites of fishes, since this part of our work was the more advanced towards completion, and we have published a joint memoir (No. 8 of the list of memoirs given below) containing the results of this part of our investigations. We are now working out our material of the blood-parasites of the Little Owl and their development in mosquitoes. Our material is not as abundant as could be desired, but we expect, nevertheless, to obtain some interesting and important results from it, and trust that by the end of the present year our results may be ripe for publication; we hope also to have another opportunity of collecting more material and continuing our investigations upon this question.

(c) *Other Researches*.—In August of last year I was invited by the Royal Society to investigate, and report upon, a collection of slides made by Sir David Bruce in Uganda, consisting of smears, preserved and stained, of the blood of various birds, reptiles, and amphibia. I undertook to carry out this work, and completed my report by the end of the year; it is now published (No. 2 below). No new or unknown types of parasites were found in the preparations, but a number of interesting forms of trypanosomes, hæmogregarines, halteridia, &c., were figured and described by me. Amongst these special attention may be drawn to the huge trypanosome from a toad, which I identify as *Trypanosoma mega*, Dutton and Todd, and to the forms of Halteridia occurring in various birds collected by Sir David Bruce. In different birds the Halteridia present such striking variations of structure and appearance, that there can be no doubt that they belong to distinct and well-characterised species. Hitherto no attempt has been made to distinguish Halteridia by structural characters; when these parasites have received distinct specific names, the distinction has been based solely upon the parasites being found in distinct species of birds. There is no reason to suppose, however, that a given species of halteridium is necessarily confined to one species of avian host, and to base the species of any class of parasites solely on the species of the hosts they infest is a very unsafe proceeding.

When dissecting fleas in order to find the developmental stages of *Trypanosoma lewisi*, it has frequently happened that I have found in the fleas other parasites, which have nothing to do with the trypanosome in question. I have studied the parasites found by me and have written a memoir (3) on them, which I have communicated to the *Festschrift* published in honour of Professor R. Hertwig, the renowned professor of Zoology at Munich. The most noteworthy of these parasites is a protozoan parasite of the Malpighian tubules, and a species of *Cysticercus* found in the body-cavity. The parasite of the Malpighian tubules I have named *Malpighiella refringens*; it appears to be allied to the amœbæ, and perhaps more particularly to *Amœba blattæ*, a common intestinal parasite of the cockroach. The *Cysticercus*, or bladder-worm, is probably a larval stage of a tapeworm occurring in the rat. Its discovery in the flea has excited some interest amongst helminthologists, and further studies, chiefly of an experimental kind, are being undertaken upon it by my colleague, Dr. W. Nicoll, of the Lister Institute, who is of opinion that it is the larval stage of *Hymenolepis diminuta*, a common tapeworm of the rat.

Having in my possession a quantity of preserved material and sections of calcareous sponges, Miss Robertson and I have studied in these preparations the division of the peculiar "collar-cells," a type of cell only found in sponges and in the order Choanoflagellata of the Protozoa (Flagellata). Our object was to observe more especially the behaviour of the centrosome and blepharoplast, in order to obtain further data for deciding the very vexed question of the nature of the two nuclear bodies in trypanosomes. At present there is no agreement or uniformity in the nomenclature employed in different countries and by different people for the body which we prefer to term the kinetonucleus of a trypanosome, and this uncertainty depends entirely on the divergent views held with regard to the nature of the centrosome. We obtained some important results bearing on this problem from our study of the behaviour of the collar-cells in division, and have completed a joint memoir on the subject, which has been sent to the "Quarterly Journal of Microscopical Science," and will shortly be published in that journal. We find that in collar-cells one and the same body functions at one time as a

blepharoplast and at another time as a centrosome, and that the blepharoplast-centrosome is not a body of the nature of a nucleus. We conclude that centrosomes and blepharoplasts, in general, are bodies of identical nature, and perfectly distinct from true nuclei. Extending this reasoning to the structural elements of the trypanosome body, we conclude that the kinetonucleus, since it has been shown to have the structure and composition of a true nucleus, should not be regarded either as a centrosome or a blepharoplast, these being the two terms most commonly applied to it, especially on the Continent.

As stated above, however, I visited the Sutton Broad Laboratory at Easter and made some observations on the blood-parasites of the fishes in the Broad, more especially those of the perch, pike, and eel. I was in hopes that at that time of year I might obtain some phases of the multiplication of these parasites, a process which still remains a mystery. I have not yet had time to work through all my preparations thoroughly, but so far I have found some interesting facts with regard to these parasites at that season, which I hope to work out when opportunity presents itself. I have suggested to Miss Robertson that she should study the goldfish in the pond at Queensberry Lodge, Elstree (the serum-branch of the Lister Institute), since all the goldfish in this locality are infected with trypanosomes. She is acting upon my suggestion, and has already made some interesting observations, upon which, however, it would be premature to report at present.

At the Anniversary Meeting of the Linnean Society this year, I was presented with the newly-founded Trail Award and Medal, this being the first award. In my speech acknowledging the award, I propounded my views with regard to the nature and primary form of the living substance. My remarks will be printed *in extenso* in the Journal of the Linnean Society.

In addition to the investigations mentioned in the foregoing paragraphs, I am engaged in writing a manual of protozoology, which I propose to call "An Introduction to the Study of the Protozoa," or some similar title. At present I have completed the first draft of the general part of the work, and am occupied with the special part, which involves a great deal of reading and bibliographical research; when the special part is finished I intend to revise the general part and prepare the whole for publication. I have also got a number of figures ready to illustrate the book.

2. *Teaching Work.*—I may conveniently divide my teaching work into (a) my formal course of lectures, and (b) informal instruction or help given by me to people working in my laboratory, or by correspondence.

(a) In the months of January, February, and March of this year I gave a course of 16 lectures, the subject being "Protozoan Parasites, with special reference to those of man." The lectures were delivered at the Lister Institute on Mondays and Thursdays, at 5 p.m. Each lecture was followed by an exhibit of microscopic preparations illustrative of the subject of the lecture. In this course, which is one I have not given before, I went as fully as time permitted into the various disease-producing protozoan parasites of man and domestic animals. The course was well attended, the average attendance being about twenty, including a large proportion of medical men. At first the lectures were delivered in the new lecture-theatre of the Lister Institute, but as the heating appliances of the theatre were not found satisfactory, a room in the building was fitted up temporarily, and the rest of the course was given there. As was the case last year, the demonstrations following the lectures were hampered by lack of microscopes, and I can only repeat what I said in my last report (Cd. 4999, p. 50), that a grant of money to be expended on the purchase of microscopic apparatus is urgently needed.

(b) We have had a considerable number of workers in the protozoological laboratory this year, and at one time every available work-place was occupied. The number of those who desire to study the Protozoa seems to increase steadily, and if it continues to do so, I anticipate a difficulty in providing room for those who come to my department; a difficulty which has, in fact, arisen already. At one time two gentlemen occupied the same work-place on different days of the week.

A small number of people occupy permanently places in the laboratory, and are engaged in research. Such are:—

Dr. J. D. Thomson, who, as stated above, is collaborating with me in the investigation of the life-history of *Trypanosoma lewisi*.

Mr. J. S. Dunkerly, demonstrator of zoology at the Birkbeck Institute, who is studying the Flagellata with a view to preparing a thesis for the degree of Doctor

of Science in London University. He has published two memoirs on the Choanoflagellata (Nos. 16 and 17 below), and works steadily during the rather scanty leisure afforded him by his official duties.

Dr. W. Cecil Bosanquet, who gives such time as his professional duties permit to researches on various parasitic Protozoa, especially spirochætes. He has published two memoirs during the past year (Nos. 14 and 15 below), and has other works in hand.

The following have visited the laboratory for the stated periods during the past year:—

Dr. W. M. Aders has been working here during May and June of the present year, studying methods of technique and increasing his knowledge of protozoan parasites generally.

Surgeon E. L. Atkinson, R.N., has been studying Protozoa generally, and especially methods of collecting and preserving them, from January to June, 1910. He has now sailed on the Antarctic Expedition, and hopes to carry on protozoological investigations on the expedition.

Mr. T. Faithfull Davies, of the Royal Veterinary College, has worked here occasionally during the past year, studying more especially methods of technique and the internal anatomy of biting insects.

Dr. H. L. Duke, late of Guy's Hospital, recently appointed to the Uganda Medical Service, studied technique and culture-methods during April, May, and part of June of this year, with a view to preparing himself for work and research in Uganda.

Captain Gloster, I.M.S., has been working here since April, studying Protozoa generally and methods of technique, and also assisting Major Liston in his researches.

Professor F. A. Janssens, of the University of Louvain, came to us from January to March of this year. He attended my course of lectures, and has been studying Protozoa generally and methods of technique. Professor Janssens had a mission from the University of Louvain to study the working of the department, in order to start a protozoological department in Louvain.

Mr. R. Kirkpatrick, of the British Museum of Natural History, has been an occasional worker in the laboratory during the present year, studying methods of microscopical technique.

Staff-Surgeon M. Kumagawa, of the Japanese Imperial Navy, has been working here since December, 1909, studying Protozoa generally and methods of technique.

Mr. W. F. Lanchester, late of King's College, Cambridge, has occupied a place here since January, and has been studying the anatomy and breeding habits of the rat-flea.

Sir E. Ray Lankester, K.C.B., F.R.S., was engaged in some researches, which he hopes to continue, on the Cyanophyceæ, during the month of February.

Major W. Glen Liston, I.M.S., has been occupied from April to June, 1910, with investigations on amœbæ causing human dysentery and liver-abscess. He has obtained some very interesting and important results, which I hope he will shortly publish.

Captain A. E. Ordbrown, of Johannesburg, has been studying parasitic Protozoa generally since the beginning of May.

Dr. Graham U. Smith studied Protozoa generally and methods of technique from October to December, 1909.

I have been in correspondence with the following gentlemen upon protozoological questions, such correspondence involving in every case examining and reporting upon specimens sent to me by them, and advising them to the best of my ability.

Major C. F. Bishop, of the Dove Marine Laboratory, Cullercoats; *re* parasites in the blood of marine fishes.

Alfred Heneage Cocks, Esq., Poynetts, Skirmett, Henley-on-Thames; *re* parasites in a dead shrewmouse.

Professor Walter S. Collinge, Uffington, Berkhamsted; *re* blood-smears of cattle, &c., from Rhodesia.

Dr. J. B. Davey, Medical Officer, Nyasaland Protectorate; *re* trypanosomes in a smear of the intestinal contents of *Glossina fusca* (a species of tsetse-fly).

C. Harold Drew, Esq., Beit Research Fellow; *re* Sporozoa (*Glugea* sp.) in a fish, *Gadus luscus*.

Captain E. D. W. Greig, I.M.S.; *re* bodies found in sections of the stomach of a cat which died when under experiment. I stated it as my opinion that the bodies in question were pathogenic amœbæ, probably identical specifically with *Amœba histolytica*, the cause of human dysentery. The chief interest of this lies in the fact that these amœbæ have not hitherto been observed to my knowledge in the stomach, being usually found in the large intestine.

Dr. Herbert Henry, Pathology Department, University of Sheffield; *re* parasites in the blood of marine fishes.

Dr. H. Herbert, F.R.C.S., Nottingham; *re* bodies in the corneal epithelium in dendriform keratitis.

Dr. H. B. Hutchinson, Rothamsted Experimental Station, Harpenden; *re* Protozoa occurring in the soil. It has been found that these Protozoa play an active part in devouring the bacteria in the soil, and that by treating the soil with substances which destroy the Protozoa, but which do not injure the spores of the bacteria, the fertility of the soil can be greatly increased. This is an interesting point as showing that the study of the free-living Protozoa may be of importance from the purely human and practical point of view, no less than that of the parasitic species.

Dr. R. E. Montgomery, Veterinary Pathologist, British East Africa; *re* coccidial disease of oxen.

Dr. R. Row, Bombay; *re* development and transmission of the parasites of Oriental Sore.

The following gentlemen have presented preparations or material to the Department:—

Sir David Bruce, K.C.M.G., C.B., F.R.S. (Slides of African blood-parasites.)

C. C. Dobell, Esq., Fellow of Trinity College, Cambridge, and Assistant in the Zoological Department, Imperial College of Science and Technology. (Preparations of intestinal Protozoa of frogs.)

G. Harold Drew, Esq. (Preparations of *Glugea* sp. in *Gadus luscus*.)

Captain E. D. W. Greig, I.M.S. (Preparation of intestinal amœbæ.)

Dr. Herbert Henry, University of Sheffield. (Preparations of blood-parasites of fishes.)

Messrs. C. Mathis and M. Léger, Institut Antirabique et Bactériologique, Hanoï, French Indo-China. (Slides of blood-parasites of fowls, &c.)

Dr. R. E. Montgomery, British East Africa. (Preserved material of Coccidia from oxen.)

Appended will be found reports by my assistants, Dr. Woodcock and Miss Robertson, and a list of papers published from this Department during the year covered by this report.

In conclusion, I should like to offer the Committee a suggestion as to the bodies described and figured by Dr. Aldo Castellani in his report for the year 1909 (Cd. 4999, p. 110 and plate to face). I believe that these bodies, found in man by Drs. Willey and Castellani, in Indian bulls by Dr. Castellani, and in man by the brothers Sargent, may very possibly be the spores of parasites belonging to the order Sarcosporidia, which have got into the blood. Sarcosporidia are known to occur commonly as parasites of cattle and domestic animals, and occasionally of man. In a special report on Sarcosporidia and their association with "Loco" disease and Dourine, published by the Department of Agriculture, Ottawa, Health of Animals Branch, 1908, and reprinted in the "Journal of Comparative Pathology and Therapeutics," March, 1909, Dr. E. A. Watson has shown that the spores of Sarcosporidia may pass into the blood, in an animal infected by them, and probably account for the "crescentic bodies" that have frequently been described as developmental stages of trypanosomes. I offer this suggestion for what it is worth.

E. A. MINCHIN.

Lister Institute,
July 8th, 1910.

REPORT by H. M. WOODCOCK, D.Sc., Lond., Assistant to the Professor of Protozoology, on work done during the year ending June 30th, 1910.

My work during the past year may be considered under the two headings of :
(a) Assistance to the University Professor, and (b) Research.

(a) Professor Minchin gave his annual course of lectures during the Spring term this year, from January to March inclusive, twice a week. During this period a very considerable portion of my time was occupied in preparing specimens for, and generally arranging, the exhibits accompanying the lectures. Other general work done includes the attention given incidentally to our cabinet of protozoological slides. This collection has now become, I am glad to say, fairly comprehensive, and includes examples of all the important types of parasitic Protozoa; many of the slides being of particular interest. In this connection, we gratefully acknowledge the kindness of several other workers in the same field, who have presented us with specimens of the parasites which they themselves have found or described. Hence, not infrequently, we were able to show at our demonstrations—side by side with a memoir relating to some piece of research—an actual example or phase of the parasite therein described, which had been given us by the author of the research. That real interest was taken in our exhibits is shown, I think, by the fact that several who attended the course would come half an hour, or even more, before the time at which the lectures were advertised to commence, in order to have sufficient time to study and make sketches of the specimens on view. The lectures, which dealt chiefly with human parasites, were of more than usual interest this year, particularly those concerned with the amœbæ and the trypanosomes; and, altogether, I think the course was most instructive. At any rate, that opinion was expressed by more than one visitor.

I have given general advice and assistance, so far as I was able, to the research workers in the laboratory. I may mention here that I handed over to Dr. Bosanquet some material which had been sent me for examination, in which two new Myxosporidian parasites were present. These have been described by him in a note (15) published in the Zool. Anzeiger. Also, recently, a section of the kidney of a mouse was handed to me from Dr. Boycott, which proved to contain the interesting Coccidian parasite known as *Klossiella*. Some years ago, I published some critical remarks on this parasite. In the present specimen, I found a condition of affairs quite similar to that obtaining in the case originally described by Smith and Johnson: and it is perfectly clear that only *schizogony* (the endogenous reproductive cycle) is in progress. I suggested to Captain Gloster, I.M.S., that he should endeavour to get more infected material from the same source and attempt to ascertain the character of the sporogonic part of the development, the knowledge of which is essential to the determination of the near affinities and systematic position of this peculiar form. This Captain Gloster intends to do, if the opportunity is afforded him.

(b) *Research*.—On settling down again in the autumn at the Lister Institute, after my return from Rovigno, I began, in conjunction with Professor Minchin, the study of the material obtained during our stay abroad. We decided to work out, first of all, our preparations of piscine Hæmatozoa, which we had made during the periods when circumstances hindered the progress of our research on the parasites of the Little Owl (cf. Report for last year. Cd. 4999, p. 49). We have been able to record certain interesting observations and notes on points of detail, as a result of this study, in a memoir (8) which was published in last April. Briefly summarised, the more important facts brought forward by us are as follows:—A new Hæmogregarine (*Hæmogregarina rovignensis*) parasitic in a gurnard (*Trigla*), was found to occur under three types or forms. Of these one, which we regard as the ordinary type of “schizont,” is very small, being one of the smallest Hæmogregarines so far described. The other two types met with are much larger and present such constant differences in appearance and structure that they are undoubtedly to be regarded as sexual forms of male and female character respectively. Various considerations led us to consider further that these forms are the actual gametocytes, which will themselves become, or directly give rise to, the gametes, upon passing into the invertebrate host, whatever this may be. It is distinctly interesting to find such definite and well-marked sexual differentiation in a Hæmogregarine, as occurs in this parasite. We were able, also, to compare minutely the essential structure of the nucleus of this Hæmogregarine with that of a trypanosome (*T. raiæ*, of the skate), using in both cases exactly similar methods of fixation and staining-methods of proved value in the study of nuclear detail. We have found that the nuclear structure of this Hæmogregarine—and there is every reason to suppose the same is true of other Hæmogregarines—is entirely different from that of a trypanosome. This is a most important fact, since it is a strong argument

against supposing that these two types of parasite are closely connected with, or allied to, one another.

Before going on to study our material relating to the parasites of the owl, I turned back, as it were, and grappled finally with my memoir on the parasites of the chaffinch and redpoll. This work has suffered a sad delay in publication, owing to the fact that all the time I was away I had no opportunity of writing up my observations, nor of completing and arranging my series of drawings. I am glad to say I have now got this off my hands, and I am hoping that it will appear shortly in the "Quarterly Journal of Microscopical Science." In former reports I have described several of the observations which are now collected together in this paper, so that I need not repeat them here. I may perhaps indicate briefly, however, the general scope of the work. In the first place, it is an attempt to show, from observations upon a trypanosome of the chaffinch and upon what is in all probability the same species of parasite from a redpoll, made at different periods of the year, the great polymorphism, *i.e.*, diversity of form and size, which may occur in different individuals of one and the same species of Avian trypanosome. The important bearing this has upon the too common practice of describing and naming species from single or scanty observations is thus evident. Secondly, a thorough and detailed study is made of the normal cultural forms of the trypanosome. The different types observed are then compared with the forms of Flagellates which have been described by various authors from blood-sucking invertebrates, and the remarkably close correspondence between the two is shown. From this study alone, the conclusion is almost irresistible, in my opinion, that the latter, *i.e.*, the parasites occurring in blood-sucking invertebrates, are derived from vertebrate trypanosomes and are not, as Patton and others try to make out, solely parasites of the invertebrate host. This is probably true in all cases, another instance being given below. Incidentally, it is seen that the cultural method may be of considerable value, not only in determining the presence or absence of trypanosomes in a case, such as that of a bird, where the infection is generally extremely scanty, but also in affording useful indications of the developmental phases which occur in the invertebrate.

I next summarise my observations, already published, on the nuclear condition found in the *Halteridium* parasitic in the chaffinch. Further endeavours to find actual transitional phases between this type of parasite and a trypanosome, have met with no success, either in the case of this species or (up to the present) in the case of *Halteridium noctuæ*, the parasite of the Little Owl. Hence I feel obliged to reconsider my position in regard to the view, which I have hitherto supported, of an actual ontogenetic connection between these two types of parasite. At present, I do not think there is sufficient evidence to show that such a connection exists; the question still remains uncertain. The observations I have made, however, as also those of certain other workers, do suggest very strongly that there is a close phylogenetic relationship between these two parasites. On this ground, the remarkable "free" individuals, with a flagellar thread, which puzzled me very much, are readily capable of explanation.

Lastly, my paper includes a short account of a new *Leucocytozoon*, which is shown, quite clearly, to be parasitic in a leucocyte and not in an erythroblast. This *Leucocytozoon* is interesting in that it does not cause the cytoplasm of the host-cell to become elongated and spindle-like; the leucocyte retains a more or less rounded form, its nucleus lying like a horseshoe or crescent, at one side of the parasite.

I have now begun, in conjunction with Professor Minchin, the study of the developmental phases of the various parasites of the Little Owl which are to be found in the mosquito. So far as can be gathered from the progress of the work up to the present, the different parasites do not seem to develop to an equal extent in this insect; while the mosquito appears to be most probably the true alternate host for the trypanosomes, it is less certainly so for the *Halteridium*, and in the case of the *Leucocytozoon*, no indications of its presence in the mosquito have yet been found. Unfortunately our mosquito-material is much too limited in quantity.

During the last month, I have had the good fortune to make an interesting discovery, which is very important in its bearing upon the question of the flagellates occurring in blood-sucking insects. A sheep kept at the Lister Institute was infested with sheep-keds (*Melophagus ovinus*) in which I found the so-called *Crithidia melophagia*, regarded by all previous investigators as a parasite peculiar

to the ked alone; but on making a careful examination of the blood of the sheep, I succeeded in finding in it a trypanosome. The parasite was obtained by examining centrifugalized blood-serum (4 or 5 c.c.), which had been removed from the contracted clot. The parasite was a typical, actively moving trypanosome, of the type of *T. lewisi*, so far as could be ascertained from the living specimen. It was seen also by Professor Minchin, Miss Robertson, and several workers in the laboratory. Miss Robertson is collaborating with me in the endeavour to obtain this trypanosome, and we very much hope to secure permanent preparations of it soon. Also numerous cultures have been made, but have not yet shown any development. The parasite was certainly extremely scarce in the blood on the day on which it was found; this may have been, perhaps, because the infection in that sheep was dying out. However, the fact is unquestionable that there is a natural trypanosome of the domestic sheep; it is also practically certain that the "Crithidial" parasites of the sheep-ked are simply the trypanomonad phases in the development of this trypanosome in its invertebrate host.

H. M. Woodcock.

REPORT of Miss MURIEL ROBERTSON, M.A., Assistant to the University Professor of Protozoology, for the year ending June 30th, 1910.

I. Research.

During the last year I have worked out the more important phases of the life-cycle of *Hæmogregarina nicoriæ*. This parasite was first observed by Drs. Castellani and Willey. It inhabits the red blood-corpuscles of the common lake-tortoise of Ceylon, *Nicoria trijuga*. The main features of the cycle are briefly as follows:—

There are two different types of the parasite to be observed in the blood-corpuscles; the one is bean-shaped or slightly recurved, the other is completely recurved upon itself, the ascending limb of the curve being as long as the descending limb. These types are generally referred to as the "bean-shaped" and "vermiform" individuals. The *Hæmogregarine* multiplies in the tortoise by the process of multiple fission ("schizogony"); binary fission was never observed. Two distinct types of schizogony occur, one in the lung and one in the circulating blood-corpuscles. The schizogony in the lung is the non-sexual endogenous multiplication by which the parasite is spread through the vertebrate host. The details are as follows:—

Certain of the bean-shaped parasites increase in size and become lodged in the capillaries of the lung; the blood-corpuscle disintegrates, but there is never any sign of the parasite entering a tissue-cell of the lung. The creature continues to increase in size considerably, and the nucleus multiplies by successive divisions. The rather elongated, sausage-like form of the parasite is preserved in spite of the great size to which it grows. Finally, the protoplasm segregates round the nuclei, and there are formed a very large number (over seventy) of merozoites, which are only little below the average size of the adult form in the circulating blood. The merozoites penetrate into the blood-corpuscles and are carried through into the general circulation.

The other type of schizogony takes place, as has been said, in the circulating blood-corpuscle; very probably it is the vermiform individuals which give rise to it, but such points cannot be settled quite definitely from observations upon natural infections. Apparently the recurved limb is re-absorbed and the form becomes bean-shaped. The whole process takes place in the blood-corpuscles, and there is no increase in size on the part of the *Hæmogregarine*. The nucleus divides up to form about six or eight daughter-nuclei, and finally six or eight very small merozoites are formed. These remain for a short time in the blood-corpuscle, and are finally set free. The merozoites produced in this way are much smaller than those formed in the lung. It appears probable that they grow up into those forms which, in the intermediate host, develop into the gametocytes.

The blood is taken into the crop of the little water-leech *Ozobranchus shipleyi*, which appears to be a specific ecto-parasite of the *Nicoria*. Certain of the *Hæmogregarines*, apparently bean-shaped or very slightly recurved individuals, become

motile in the intestine. They later penetrate into the wall of the intestine, and a differentiation into gametes appears to occur.

The conjugation takes place in a manner closely resembling that found among Coccidia of the type of *Adelea ovata*. A small microgametocyte with a dense nucleus and little protoplasm becomes associated with a macrogamete; the macrogamete becomes spherical and grows in size, and its nucleus takes on a somewhat scattered appearance. The nucleus of the microgametocyte divides up to form three or four microgametes, one of which apparently penetrates into the macrogamete, while the others remain outside and degenerate. Unfortunately, the actual moment of penetration of the microgamete-nucleus was not caught in any of the leeches sectioned. In the later stages the nucleus of the zygote divides up to form eight, and finally eight sporozoites are produced; they break out from the oöcyst, which is not at any time a resistant capsule, but only a rather thin membrane. The sporozoites penetrate through the wall of the intestine into the blood-spaces. The exact mechanism of injection into the tortoise has not been made out.

In addition to this, I have assisted Professor Minchin in working out the details of divisions of the collar-cells in the sponge *Clathrina coriacea* (see above).

Further work has been done in collaboration with Mr. C. H. Martin, B.A., upon the protozoan parasites in the intestine of the common fowl. It has been found that there are present one form of *Trichomastix*, apparently two forms of *Trichomonas*, two distinct types of *Amæba*, and also a parasite whose affinities are still rather obscure. Finally there is a flagellate closely allied to *Monocercomonas*. A good deal of work has been done upon these forms, but the research is not yet completed.

At present I am also engaged in reviewing the intestinal parasites of fresh-water invertebrates with a view to determining the occurrence of flagellates of the Herpetomonad, Crithidial, and Trypanosome types, and as a preliminary to studying the transmission of the trypanosome of the goldfish. This has the double purpose of finding out what animals show the so-called "natural" flagellates, and also of discovering the intermediate hosts of fish-trypanosomes.

Up to the present a number of leeches have been examined, mostly belonging to non-bloodsucking genera, with the following results:—*Herpobdella octomaculata* and *Herpobdella atomaria* have shown the coccidian parasite, *Orcheobius*. *Helobdella stagnalis* has shown a species of ciliate belonging to the genus *Anoplophrya*. *Glossiphonia complanata* and *Hæmopsis sanguisuga* have up to the present shown no protozoan parasites.

All these non-bloodsucking leeches have so far shown no flagellates, while two individuals of *Hemiclepsis marginata*, a species which feeds on the blood of fishes, in particular (according to Blanchard) on carp, both showed very large numbers of these parasites. The crithidial and also the fully developed trypanosome phases were present in large numbers. No stages of a *Trypanoplasma* have so far been observed.

II. Departmental work.

I have assisted Professor Minchin in the ordinary routine work of the laboratory, both in preparing the demonstrations for the lectures, and in giving informal instruction and help to people working in the laboratory.

MURIEL ROBERTSON.

LIST OF PAPERS published from the Department of Protozoology during the year ending June 30th, 1910.

By Professor E. A. Minchin:—

- (1) The Structure of *Trypanosoma lewisi* in Relation to Microscopical Technique.
 "Quarterly Journal of Microscopical Science," Vol. LIII, pp. 755-808, pls. XXI.-XXIII.
 (Vide Cd. 4999, p. 46.)
- (2) Report on a Collection of Blood-Parasites made by the Sleeping Sickness Commission, 1908-9, in Uganda.
 "Reports of the Sleeping Sickness Commission of the Royal Society," No. X., pp. 73-86. pls. 7-9.
- (3) On some Parasites observed in the Rat-flea (*Ceratophyllus fasciatus*).
 "Hertwig's Festschrift," pp. 291-302, pl. 23.

- (4) The Relation of the Flagellum to the Nucleus in the Collar-cells of calcareous sponges.

"Zoologischer Anzeiger," Vol. XXXV., pp. 227-231, 6 text-figg.

- (5) Some Applications of Microscopy to Modern Science and Practical Knowledge. (Presidential Address.)

"Journal of the Quekett Microscopical Club," Series 2, Vol. X., pp. 437-450.

- (6) Some Considerations on the Phenomena of Parasitism amongst Protozoa. (Presidential Address.)

Ibid., Vol. XI., pp. 1-18.

(With Dr. J. D. Thomson):—

- (7) The Transmission of *Trypanosoma lewisi* by the Rat-flea (*Ceratophyllus fasciatus*).

"Proceedings of the Royal Society," Series B, Vol. 82, pp. 273-285.

(With Dr. H. M. Woodcock):—

- (8) Observations on certain Blood-Parasites of Fishes occurring at Rovigno.

"Quarterly Journal of Microscopical Science," Vol. LV., pp. 133-154, pls. VIII.-X.

Also reviews on protozoological subjects in "Nature," "The British Medical Journal," "The Journal of the African Society," &c.

By Dr. H. M. Woodcock:—

- (9) Protozoa.

"Zoological Record for the Year 1908."

(*Vide etiam* No. 8.)

By Miss Muriel Robertson:—

- (10) Studies on Ceylon Hæmatozoa. I. The Life-Cycle of *Trypanosoma vittatæ*.

"Quarterly Journal of Microscopical Science," Vol. 53, pp. 665-695, pls. XVI., XVII., 4 text-figg.

- (11) Further Notes on a Trypanosome found in the Alimentary Tract of *Pontobdella muricata*.

Ibid., Vol. 54, pp. 119-139, pl. IX., 5 text-figg.

(*Vide* Cd. 4999, pp. 55-6.)

- (12) Notes on an Ichthyosporidian Parasite causing a Fatal Disease in Sea-Trout.

"Proc. Zool. Soc.," London, 1909, pp. 399-402, pls. LXII.-LXIV.

(*Vide* Cd. 4999, p. 49 and p. 56.)

(With Mr. C. H. Martin):—

- (13) Preliminary Note on *Trypanosoma eberthi* (Kent) (= *Spirochæta eberthi* Lühe) and some other Parasitic Forms from the Intestine of the Fowl.

"Proc. Roy. Soc.," Series B, Vol. 81, 1909, pp. 385-391, pl. 8.

By Dr. J. D. Thomson: *vide* (7).

By Dr. W. Cecil Bosanquet:—

- (14) A Note on the Spirochæte present in Ulcerative Granuloma of the Pudenda of Australian Natives.

"Parasitology," Vol. II., pp. 345-348, 5 text-figg.

- (15) Brief Notes on two Myxosporidian Organisms (*Pleistophora hippoglossoides*, n. sp. and *Myxidium mackiei*, n. sp.).

"Zoologischer Anzeiger," Vol. XXXV., pp. 434-438, 13 text-figg.

By Mr. J. S. Dunkerly:—

- (16) Notes on the Choanoflagellate Genera *Salpingæca* and *Polyæca*, with Description of *Polyæca dumosa*, sp. n.

"Annals and Magazine of Natural History," Series 8, Vol. V., pp. 186-191, pls. VI., VII., and 4 text-figg.

- (17) Note on our present knowledge of the Choanoflagellata.

"Journal of the Quekett Microscopical Club," Series 2, Vol. XI., pp. 19-24, pl. I.

By Captain R. McCarrison, I.M.S. :—

- (18) Observations on the Amœbæ in the Intestines of Persons suffering from Goitre in Gilgit.

"Quarterly Journal of Microscopical Science," Vol. LIII., pp. 723-736, with text-figg.

(Vide Cd. 4999, p. 50.)

Copies of (2), (4), (5), (6), (7), (8), (14), and (15) are enclosed herewith.

APPENDIX III.

REPORT BY PROFESSOR GEORGE H. F. NUTTALL, F.R.S., ON WORK OF QUICK LABORATORY.

SIRS,

October 26th, 1910.

THE accompanying list of papers, published since the appearance of last year's report upon the work conducted in the Quick Laboratory, will indicate the character of the investigations which have been carried out in our laboratory. Some of the papers deal with the subjects referred to in the previous report; others, not included in the list, are in press or in course of preparation.

REPORT FOR 1910.

In October, 1909, I was re-elected to the Quick Professorship, and Mr. Gordon Merriman was appointed Student in Medical Entomology. In May, 1910, Mr. Cyril Strickland, B.A., was appointed Assistant to the Quick Professor in place of H. B. Fantham, D.Sc., who received an appointment at the Liverpool School of Tropical Medicine.

A good deal of attention has been given to the study of East Coast fever by myself, with the assistance of Dr. Fantham and Miss Porter, and a more extended study of the disease is at present being made in conjunction with Dr. Graham-Smith and Mr. Cyril Strickland. With the latter I have been investigating biliary fever in horses, and we have succeeded in demonstrating that two distinct diseases, due to distinct species of parasites, have hitherto been confused under the one name. Further experiments on the curative treatment of piroplasmosis have been carried out, and the practical value of the Trypanblue treatment of canine piroplasmosis (Nuttall and Hadwen) has been amply confirmed by various investigators in different parts of Africa. Tests of the remedy in the case of bovine piroplasmosis (redwater) are receiving an extensive trial. Some observations of mine upon the degenerative appearances observed in *Trypanosoma brucei*, consequent upon drug treatment, are of interest, since they indicate the need of caution in interpreting certain appearances seen in trypanosomes as being developmental instead of degenerative stages. Important results have been obtained by Dr. Fantham in the study of grouse disease, since he has demonstrated the prevalence and communicability of fatal *Coccidiosis* in birds. In the course of his studies upon the biology of *Ornithodoros moubata*, Mr. Merriman was, unfortunately, bitten by infected ticks, and contracted a sharp attack of relapsing fever accompanied by periods of total blindness, which caused us grave concern. Mr. Merriman, fortunately, made a good and complete recovery, and since then has been diligently occupied in work upon the biology of *O. moubata* and other species of ticks, besides ordering the many specimens of blood-sucking arthropods which are constantly being added to our Entomological Collections and conducting investigations on behalf of the Local Government Board upon the biology, range of flight, &c., of house-flies. Mr. C. Warburton, M.A (Zoologist to the Royal Agricultural Society of Great Britain), and myself have been occupied in determining many specimens of ticks sent to us on behalf of the Entomological Research Committee (Tropical Africa) and reporting thereon from time to time, and other collections from many tropical countries are being continually sent to us for determination. Dr. Swellengrebel and Mr. Strickland have conducted, and partly published, interesting experiments upon the development of *Trypanosoma lewisi* in fleas. Mr. Strickland has been, moreover, engaged in studying the biology of the rat-flea in connection with an investigation thereon which is being directed by the Advisory Committee for Plague Investigations in India, to which I have the honour to belong. During the last year, besides Messrs. Warburton, Strickland, Merriman,

and Miss Porter, D.Sc., who are continuously engaged in research, we have had other workers temporarily occupied in the laboratory. Dr. N. H. Swellengrebel (Assistant in Protozoology at the Hygienic Institute, Amsterdam), spent some months with us doing research on trypanosomiasis. Mr. N. MacDonald (Veterinary Service, Australia), Dr. T. Yamanouchi (Tokio, Japan), Mr. J. F. Valladares (Senior Lecturer, Government Veterinary College, Madras), and Dr. Erik Nordenskjöld (Lecturer in Zoology, Helsingfors University, Finland), spent some time in the Laboratory studying parasitic protozoa and ticks. Dr. F. I. M. Jupe (Medical Officer, Gold Coast), Messrs. Neave and Simpson (Field Entomologists to the Entomological Research Committee), and, more recently, Dr. A. D. P. Hodges (Principal Medical Officer, Uganda), have been sent here by the Colonial Office for special instruction. On the other hand, Dr. E. Hindle (former Demonstrator in the Liverpool School of Tropical Medicine, holding a Beit Fellowship for Medical Research), has established himself with us during the tenure of his Fellowship with the object of pursuing investigations upon trypanosomiasis and upon spirochaetosis, subjects upon which he is at present busily engaged. Finally, Mr. F. M. Howlett, B.A., Second Imperial Entomologist, India, is spending a considerable portion of his time in the Laboratory, being here at present on leave. I may add that Messrs. W. F. Cooper, L. E. Robinson, and J. Davidson, residing in Watford, are associated with Mr. Warburton, Mr. Merriman, and myself in the studies we are pursuing upon the structure and biology of ticks.

I am, &c.,
GEO. H. F. NUTTALL.

Enclosure in Appendix III.

LIST OF PUBLICATIONS FOR THE YEAR 1910.

- Nuttall, G. H. F., Fantham, H. B., and Porter, A. (XII., 1909). Observations on *Theileria parva*, the Parasite of East Coast Fever of Cattle. *Parasitology*, II., 288-296, Plate III.
- Nuttall, G. H. F. (XII., 1909). Note on the Mode of Multiplication of *Piroplasma bovis* as observed in the Living Parasite. *Parasitology*, II., 341-343, 1 diagram.
- Porter, A. (XII., 1909). The Morphology and Life-history of *Crithidia gerridis*, as found in the British Water-bug, *Gerris paludum*. *Parasitology*, II., 348-366, Plate IV.
- Porter, A. (XII., 1909). The Life-cycle of *Herpetomonas jaculum* (Léger) Parasitic in the Alimentary tract of *Nepa cinerea*. *Parasitology*, II., 367-391, Plate V., and 1 text figure.
- Fantham, H. B. (XII., 1909). The Spirochaetes found in the Crystalline Style of *Tapes aureus*: A Study in Morphological Variation. *Parasitology*, II., 392-408, Plate VI., and 2 text-figures.
- Nuttall, G. H. F. (XII., 1909). The Drug Treatment of Canine Piroplasmiasis. *Parasitology*, II., 409-434.
- Jepson, F. P. (1909). Notes on Experiments in Colouring Flies, for Purposes of Identification, conducted under the direction of Professor Nuttall, at the Quick Laboratory, Cambridge, during July and August, 1908. *Reports to the Local Government Board on Public Health and Medical Subjects*, n.s., No. 16, pp. 4-9.
- Nuttall, G. H. F., and Jepson, F. P. (1909). The Part played by *Musca domestica* and allied (non-biting) flies in the Spread of Infective Diseases. A summary of our present knowledge (with bibliography). *Ibid*, pp. 13-41.
- Porter, A. (1909). Some Observations on Living Spirochaetes from Lamellibranchs. *Arch. Zool. expér. et gén.*, III., 1-26.
- Fantham, H. B., and Porter, A. (1909). The Modes of Division of *Spirochaeta recurrentis* and *S. duttoni* as seen in the living organisms. *Proc. Roy. Soc., London*, B. LXXXI., 500-505.
- Nuttall, G. H. F. (IV., 1910). On Haematozoa occurring in Wild Animals in Africa. *Parasitology*, III., 108-116, Plates X. and XI.
- Strickland, C., and Swellengrebel, N. H. (VI., 1910). The Development of *Trypanosoma lewisi* in the Rat-flea (*Ceratophyllus fasciatus*). *Proc. Cambridge Philos. Soc.*, XV., 531-533.

- Nuttall, G. H. F. (VII., 1910). The Degenerative Appearances observed in *Piroplasma canis* and *Trypanosoma brucei* following upon Drug Treatment. *Parasitology*, II., 202-209, 2 diagrams.
- Nuttall, G. H. F., and Fantham, H. B. (VII., 1910). *Theileria parva*, the Parasite of East Coast Fever in Cattle. *Parasitology*, II., 117-129, Plate XIII.
- Fantham, H. B. (VII., 1910). On the occurrence of Schizogony in an Avian Leucocytozoön, *L. lovati*, Parasitic in the Red Grouse, *Lagopus scoticus*. *Ann. Tropical Med. and Parasitology*, IV., 255-258, Plate XXI.
- Porter, A. (VII., 1910). The Leucocytozoa. *Parasitology*, II., 239-244.
- Swellengrebel, N. H., and Strickland, C. (IX., 1910). The Development of *Trypanosoma lewisi* outside the Vertebrate Host. *Parasitology*, III., 360-389, 21 diagrams.
- Fantham, H. B. (X., 1910). The Morphology and Life-History of *Eimeira (Coccidium) avium*: A Sporozoön causing a Fatal Disease among Young Grouse. *Proc. Zool. Soc., Lond.*, Part III., 672-691, Plates LV.-LVIII.
- Fantham, H. B. (X., 1910). Observations on the Parasitic Protozoa of the Red Grouse (*Lagopus scoticus*), with a Note on the Grouse Fly. *Proc. Zool. Soc., Lond.*, Part III., 692-708, Plates LIX.-LXI.
- Fantham, H. B. (X., 1910). Experimental Studies on Avian Coccidiosis, especially in relation to Young Grouse, Fowls, and Pigeons. *Proc. Zool. Soc., Lond.*, Part III., 708-722, Plate LXII., and Text-figure 66.
- Fantham, H. B. (X., 1910). Observations on the Blood of Grouse. *Proc. Zool. Soc., Lond.*, 722-731, Plate LXIII.

APPENDIX IV.

Reports from the London School of Tropical Medicine.

No. 1.

LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received May 12, 1910.)

London School of Tropical Medicine (University of London),
Greenwich, S.E., 11th May, 1910.

SIR,

I HAVE the honour to submit the usual half-yearly Reports of the Entomologist and the Helminthologist at the London School of Tropical Medicine. In connection with the last-mentioned report, I send you five publications* by Dr. R. T. Leiper.

I am, &c.,
P. MICHELLI,
Secretary.

Enclosure 1 in No. 1.

REPORT of the ARTHROPODOLOGIST of the LONDON SCHOOL OF TROPICAL MEDICINE
for the half-year ending 30th April, 1910.

As explained in prior reports, the work dealt with in this Department, though first and foremost entomological, includes some other branches of medical zoology—such as venomous reptiles, poisonous and venomous fishes and “shell-fish,” Mollusca that act as intermediary hosts of flat-worm parasites, blood-sucking bats, &c.—that are not otherwise provided for.

My time, as heretofore, has been employed in actual teaching, in the preparation of material for demonstration and study, and in the naming and preservation of the reference collection. These multifarious little duties fully occupy my official hours; but I have employed some of my leisure in collecting the material for a Guide to the Study of Arthropoda connected with human pathology and hygiene.

In each of the two sessions covered by the half-year I have given the ordinary course of eight one-hour lectures and 14 or 15 hour-and-a-half demonstrations on harmful arthropoda and thanatophidia, and the special advanced course, extending

* Not reprinted.

over three weeks, on arthropoda. The teaching has been made as practical as possible, and has included methods of technique.

Towards the collections a satisfactory amount of material has been received from many parts of the world, as is shown in the sequel.

The museum, where a large variety of named specimens always remain on the table for the closest inspection, has been well used, in every sense, by the students. Many preparations have been added to the teaching collection, and the reference collection has been enriched by the addition of a large number of venomous snakes from Africa.

The following is a summary of acquisitions arranged in their geographical sources :—

(a.) *Africa.*

Dr. H. E. Arbuckle : Venomous snakes, including a nice dissection of the peculiar venom-glands of *Causus rhombeatus*, from Sierra Leone.

Dr. H. Bayon : Mosquitoes and other biting and parasitic flies, ticks, *Porocephalus* and *Reighardia*, and a variety of venomous snakes, all from the Uganda Protectorate.

Cairo Medical School : A fine series of venomous snakes from Egypt and the Sudan.

Dr. W. M. Graham : A beautiful series of lantern-slides of West African blood-sucking flies.

Dr. A. W. H. Grant : Several well-preserved specimens of *Echis carinatus* from West Africa.

Dr. R. Howard : A carefully made collection of mosquitoes and parasitic insects from Likoma Island, in Lake Nyasa.

Dr. J. M. O'Brien : Ticks from Kumasi.

Dr. R. W. Oppen : *Glossinæ* from Sierra Leone.

Dr. E. H. A. Park : Ticks from Nyasaland.

Dr. Arthur Pearson : *Glossinæ* from West Africa.

Dr. L. Sells : Blood-sucking flies and some snakes from Uganda.

Transvaal Museum : A large series of South African snakes, including a specimen of the dangerous *Opisthoglyphe*, *Dispholidus typus*. This donation is due to the very kind intercession of Dr. L. Bostock.

Dr. G. A. Turner : Ticks and snakes from South Africa.

(b.) *America.*

Dr. Blue : A series of species of rat-fleas from San Francisco.

Dr. R. Gonzalez : Blood-sucking flies from Venezuela.

Dr. H. G. Johnston : An extensive collection of mosquitoes and other blood-sucking flies from Jamaica.

Dr. A. King : Specimens of fleas and of the *Fer-de-lance*, from St. Lucia.

Dr. K. S. Wise : Mosquitoes from British Guiana.

(c.) *Asia.*

Major A. T. Gage, I.M.S. : Venomous snakes from Bengal.

Major S. S. Harriss, I.M.S. : Blood-sucking flies from the Punjab.

Indian Museum : A large number of *desiderata* in the way of parasitic and blood-sucking flies; also rats and a snake.

Dr. W. Woolliscroft : Ticks and bugs from Southern India.

Prof. R. Newstead of the Liverpool School of Tropical Medicine : Specimens of two species of Oriental *Culicoides*.

British Museum (exchange) : Some named specimens of Oriental *Tabanus*.

(d.) *Miscellaneous.*

Dr. A. G. Bagshawe : Publications of the Sleeping Sickness Bureau

Professor R. T. Hewlett : Larvæ of British *Culex*.

Professor G. H. F. Nuttall, F.R.S. : Duplicates of 12 named species of ticks from his collection.

Major H. J. Walton, I.M.S. : European *Tabanus*.

Dr. Herbert Williams : Barley infested with meal-worm and *Calandra oryzae*, from a ship's cargo.

Information and assistance have been given to several visitors and numerous correspondents. At my suggestion Dr. H. E. Arbuckle, of the West African Medical

Service, made some experiments with the fresh venom of the African viperid *Causus rhombeatus*. This viperid, which is very common in Tropical Africa, is superficially much more like a colubrine snake than a viper, as its head is covered with large symmetrical shields. According to Dr. Arbuckle, its venom, though undoubtedly of the viperine type (causing great swelling and damage at the site of inoculation and marked destruction of the blood), also shows something of the neurotoxic quality characteristic of colubrine venom. This is an interesting peculiarity, in view of the colubrine *facies* of this species. Dr. Arbuckle also made the discovery that the venom-glands of *Causus rhombeatus* are of great length and are not in any part of their extent covered by muscle, but contain (probably in their capsule), a proper muscular element that is capable of ejecting the venom through the fangs.

Some named ticks and a *Causus rhombeatus* have been given to the Indian Museum in exchange; a few specimens of flies have been given to the British Museum; and a few named specimens of the commoner hurtful *Arthropoda* have been given to advanced students.

A small exhibit of some of the more notorious insects concerned in the dissemination of disease was lent to the Curator of the West Ham (Essex County) Museum for a conversazione.

A. ALCOCK,
Lieutenant-Colonel, I.M.S. (Retired List).

25th April, 1910.

Enclosure 2 in No. 1.

REPORT OF THE HELMINTHOLOGIST.

I have the honour to submit a Report upon my work as Helminthologist to the London School of Tropical Medicine during the half-year ending 30th April, 1910, and to forward reprints of papers published during the same period.

Teaching.

(a.) The lectures and laboratory instruction in helminthology that form part of the School "Certificate" Curriculum were given as usual.

(b.) Two advanced courses of practical instruction, each of three weeks' duration, were held and were well attended. This course of advanced helminthology, initiated last May, appears to meet a need for practical and individual training in methods of helminthological investigation. It is satisfactory to be able to report that there have attended during the year 18 graduates, viz. :—

Colonial Medical Services	...	...	6
Indian Medical Service	...	...	2
Veterinary	...	...	1
Private	...	...	9
			18

(c.) Special instruction in general helminthology and in methods of investigation was given, at the request of the National Antarctic Expedition, to one of the members of the party who intends to specialise in this subject.

(d.) Three of the "Lectures to Nurses on Tropical Subjects" were given by me. I also acted as one of the examiners at the conclusion of the series.

Investigation of Material, &c.

A considerable quantity of preserved material has been forwarded to me for determination and report by various correspondents. Several inquirers have been supplied with special information regarding their specimens, and others have been assisted with the literature.

At the request of the Medical Secretary of the Entomological Research Committee (Tropical Africa), I have undertaken the identification of the parasitic worms that are arriving from their collectors in Africa.

Dr. Stanton has continued to supply me with excellently preserved material from the Malay States; his collection bids fair to become the most important yet made in that region. A special word of thanks and commendation is also due to Dr. Sells, who has been equally indefatigable in Uganda.

A large quantity of tapeworms has been received from the Punjab Veterinary College, and the Indian Museum has also sent specimens for identification. Smaller lots have been received from various sources, but the material is so varied that it has not been possible to do more than report briefly upon it.

Bibliographical Work.

As the literature of helminthology forms an almost insuperable barrier to investigators stationed in the Tropics, for some time past I have devoted a considerable part of my own time to the compilation of a series of card index catalogues of helminthological literature. These catalogues are now proving of service to correspondents in England as well as abroad. During the last six months a catalogue of all the helminthes known to occur in domesticated animals has been added to the series. The catalogue of the genera of leeches is gradually acquiring its full complement of species. A new series of the genera and species of mollusca that act as intermediaries in the life cycle of trematode worms has been commenced. For experimental investigation of the development of the trematoda of man and domesticated animals a knowledge of the molluscs that can act as efficient hosts is almost essential.

Original Investigations and Communications.

Of the printed papers appended to the Report, four were in the Press when the last report was presented and were referred to therein. The fifth paper deals with "Guinea-worm in Domestic Animals, with a Note of its Discovery by Mr. Charles Grey, in a Leopard," and is reprinted from "Journal of Tropical Medicine," January, 1910.

A number of short communications were made during the winter to the Zoological Society of London, and of these brief notices have been published in the "Abstract of the Proceedings" of the Society. They deal with:—

1. A nematode from the body cavity of the tsetse fly.
2. The nematode parasites of the London cab horse.
3. The filaria worm *Acanthocheilonema dracunculoides* and its relation to *Filaria perstans*.
4. The development of the *Trichostrongylus pergracilis*, the causal factor in grouse disease.
5. On the mode of entry of nematode embryos into cyclops.

A systematic paper on the entozoa of the hippopotamus was also communicated to the Zoological Society, and the final proofs have been passed for publication in the Proceedings on June 1st, 1910. This paper records the finding by Dr. Sells and myself of twelve species of parasitic worms, of which eleven are new. Three of these are of interest on account of the light they throw on the systematic position of related forms living in man.

Dr. Turner, of the Transvaal, continues to supply us with valuable material from his post-mortems. In a previous report I described the occurrence in a native of Nyasaland of a very rare nematode *Triodontophorus deminutus*. During the past six months Dr. Turner has sent me examples of the same parasite from three more cases, and a fourth case has been found by the Medical Officer of Lourenço Marques. The parasite seems, therefore, to be of more frequent occurrence than has been supposed. Doubtless it has been overlooked owing to the similarity in the size and shape of its body and of its eggs to those of the ankylostome worms. I have in preparation a paper upon the structure of the male worm and the classification of this species.

Dr. Christopherson, Director of the Civil and Military Hospital of Khartoum, has enabled me to record the presence of the *Necator americanus* in the Bahr el Ghazal. We are also indebted to him for an apparently new *Echinorhynchus* from the dog and an extraordinary large immature round worm—apparently an *Acanthocephala*, but lacking a hooked restellum—from a native of the Sudan.

On the suggestion of a number of people I have begun some studies upon the development of the forked worm *Syngamus trachealis* that causes the loss of such large numbers of poultry in England each summer, but at present I have nothing to report upon these investigations.

In February certain Japanese authorities announced that they had experimentally demonstrated that the miracidium of the Bilharzia worm (*Schist. japonicum*) penetrated the skin and acquired maturity within a month without intermediate

host. At my request Dr. Newham subcutaneously injected a large number of living *Bilharzia miracidia* into a monkey, but although two months have since elapsed there are still no signs of infection. The problem apparently is one that still urgently calls for investigation.

The *Helminthological Museum* has again been enriched with many valuable additions from various parts of the world, it being the rule that samples of all material reported upon are retained for its service.

The continual growth of the collections, the increase in the number of workers who frequent the department, the need of extra accommodation and of assistance for bibliographical work, the opportunities of conducting experimental investigations into problems of high economic importance that are arising, all emphasize the urgent necessity for some radical change in the housing of the Department.

ROBERT THOMSON LEIPER.

No. 2.

REPORT OF THE PROTOZOOLOGIST FOR THE HALF YEAR ENDING
30TH APRIL, 1910.

(Received in Colonial Office, 7 July, 1910.)

The work in the Department of Protozoology has been conducted on the same lines as indicated in the preceding report.

Teaching has occupied a considerable portion of the first three months of this time. The second three months has been occupied chiefly in making preparations for the expedition to Bagdad and in travelling there.

The teaching has involved as usual instruction in Protozoology in the portion of the general course allotted to this purpose, and also in conducting advanced classes in protozoology, which continue to attract students. It may be emphasised again that the advanced classes cover chiefly the more applied methods of studying the protozoa with the aim that students undertaking this course will be more able to pursue investigations of their own when in the tropics. To this end the advanced classes are almost entirely of a practical nature.

During my absence in Bagdad the advanced classes in protozoology have of necessity ceased, but they will be resumed on my return.

Though certain advances have been made in the laboratory accommodation for the advanced classes in protozoology, there is still much room for improvement before the classes can be conducted to the greatest advantage, and with the necessary comfort to the student.

Certain investigations have been made during the period covered by this report. These have reference chiefly to the protozoal fauna of the human intestine, and are continuations of researches which have been reported upon from time to time.

An interesting case of *Entamoeba tetragena* was examined. For the opportunity of examining this case I am indebted to Professor W. J. Simpson. The case was of a man from India who had suffered from dysentery, and whom I found to harbour the *Entamoeba tetragena*, an *Entamoeba* which has at present been reported from only a very small number of cases. Its identity as a distinct form of *Entamoeba* of the human intestine has only recently been recognised. On this account the occurrence of this case from India is of much interest.

An intestinal protozoon belonging to the group of the *Flagellata*, and hitherto undescribed, was discovered in a patient from the West Indies. This parasite resembles in general body form the common *Trichomonas* for which it was at first mistaken. It differs from the *Trichomonas*, however, in the absence of the undulating membrane, which winds in a spiral manner round the body. It is also to be distinguished by the presence of a very large cytostome within which is what is probably a very delicate undulating membrane. There are three anteriorly-directed flagella terminating in a micronucleus close to which lies the large vesicular nucleus. The nearest ally to this flagellate is one that has been described from the intestinal tract of an Amphibian, and which, on account of its large cytostome, has received the generic name of *Macrostoma*. In this genus, the new human flagellate has been provisionally included. A paper describing this flagellate has been sent in for publication.

Another flagellate, which appeared in some material being used for the investigation of *Entamoeba coli*, has been the object of certain observations. This is a *Cercomonas*, an organism whose structure and affinities have been the subject of much controversy and doubt. It has been described from the human intestine on many occasions, and there have been confused with it many organisms quite distinct. It is hoped that the paper describing these observations will disperse much of the obscurity in which this flagellate is enveloped.

A third paper dealing with the *Leucocytozia* and *Hæmogregarina*, two groups of blood inhabiting protozoa has been sent for publication. Owing to my absence abroad I am unable to state if the above-mentioned papers will be ready to accompany this report.

The investigations on Oriental sore, on which I am now engaged in Bagdad, are in progress, but their incompleteness at the present time does not permit of a report being made.

C. M. WENYON,
Bagdad.

No. 3.

LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 16 November, 1910.)

London School of Tropical Medicine (University of London),
Greenwich, S.E., 15th November, 1910.

SIR,

ENCLOSED I have the honour to send you the half-yearly reports of the Entomologist, the Helminthologist, and the Protozoologist at the London School of Tropical Medicine.

I am, &c.,
P. MICHELLI,
Secretary.

Enclosure 1 in No. 3.

LONDON SCHOOL OF TROPICAL MEDICINE.

REPORT of LIEUTENANT-COLONEL A. ALCOCK, C.I.E., I.M.S., Lecturer on Entomology and General Medical Zoology, for the half-year ending 31st October, 1910.

As explained in former reports, a good deal of miscellaneous work in medical zoology is done in the Entomological Department.

Most of my time has been occupied in teaching and in attending to the collections which furnish the material for practical study and for prospective research work.

Much has been added to the collections, of which the following is a summary :—

- (a) *Europe*.—Professor R. T. Hewlett has presented a large number of specimens of the malaria-carrying mosquito *Anopheles maculipennis*. Dr. A. Hutton has presented a great many aquatic larvæ and pupæ of various flies, *e.g.*, *Chironomus*, *Corethra*, *Dixa*, *Simulium*. Both Professor Hewlett's and Dr. Hutton's donations will be of the greatest use for practical study in the classes.
- (b) *Asia*. From Dr. N. Annandale of the Indian Museum valuable series of named *Culicidæ* and *Centipedes* have been received. Major H. C. Brown, I.M.S., Dr. H. Preston Maxwell, and Dr. W. Woolliscroft have sent fine specimens of venomous snakes, all of which have been identified and incorporated in the School Collection. Captain A. B. Fry, I.M.S., and Dr. A. T. Stanton of Kuala Lumpur have forwarded examples of their local mosquitos, and Dr. W. Woolliscroft has been constant in his consignments of insects of practical importance from the Medical Officer's standpoint.
- (c) *Africa*.—From the Sudan and East Africa we have received specimens of noxious insects and venomous snakes, Drs. Geoffrey Carpenter, J. B. Christopherson and L. Sells being the donors. Dr. Sells's donations deserve special notice as being the largest and the most varied.

Numerous officers of the West African Medical Service who have been at different times connected with the School have been kind enough to remember our wants. Dr. H. E. Arbuckle has brought venomous snakes, ticks, and biting flies. Dr. T. R. B. Browne has sent a supply of larvæ ticks. To Dr. D. Burrows we are indebted for venomous snakes, centipedes, a *Tabanus* (*T. argenteus*, Surcouf) which attacks poultry, "sucking blood from the comb and leaving weeping scaly sores," and specimens of *Glossina palpalis*. Dr. Connal has given a specimen of *Porocephalus*. Dr. A. W. H. Grant sends a "Mamba" (*Dendraspis jamesonii*), one of the most aggressive of the venomous snakes of Africa. Dr. F. Jupe has presented specimens of *Causus rhombeatus*, *Bitis nasicornis* and *Naja melanoleuca*, three common venomous snakes. Dr. A. E. Neale has brought scorpions, larvæ of parasitic flies, and venomous snakes—among the last a specimen of *Atractaspis aterrima*. Dr. J. M. O'Brien has sent another consignment of well-known blood-sucking flies and mosquitos. Dr. J. Pearson has again presented centipedes and venomous snakes. Dr. J. Pollard has brought some useful *Glossinæ* and *Tabani*. Dr. F. H. Storey has ticks and blood-sucking flies (*Glossina* and *Hippobosca*). Finally, Dr. J. C. Thomson has presented a bug of the genus *Conorhinus*, an important blood-sucking form.

The only South African donations are a fine series of larvæ, nymphs, and adults of a notorious tick—*Rhipicephalus appendiculatus*—from Dr. G. Turner; and specimens of a moth whose caterpillar is occasionally noxious to man from Dr. F. M. Sandwith.

- (d) *Australian Region*.—Dr. C. L. Strangman has sent a fine collection of snakes, including several much wanted venomous species, from Port Darwin; and Dr. P. H. Bahr has sent two small consignments, chiefly mosquitos of medical importance, from Fiji.
- (e) *America*. Dr. H. G. Johnston, of Jamaica, has sent a fine supply of larvæ and pupæ of *Stegomyia fasciata*; from Dr. S. M. Laurence, of Trinidad, we have received a good series of larvæ, pupæ, and adults of *Apiochaeta ferruginea*—a curious fly, the larva of which has been observed as an intestinal parasite of man in several parts of the world; and Dr. H. B. Newham has brought back specimens of malaria-carrying mosquitos, of screw-worm flies, and of snakes, from British Guiana. Some centipedes from Dr. Alex. King, of St. Lucia, must also be mentioned.

As regards teaching, in addition to the ordinary classes which form part of the school curriculum, I conducted a special course of entomology for officers of the African Colonies during the summer session. Fourteen officers attended this course, which occupied the entire morning (10.30 a.m. till 1 p.m.) of fifteen days. All the more important groups of Arthropoda were noticed, and particular attention was paid to those forms which the medical and the sanitary officer are expected to recognize and to be on the watch for.

In connection with teaching, I may mention that the departmental museum is always open and has been freely utilized.

I have not myself undertaken any research with a view to publication, for the main reason that the preparation of material for teaching purposes continues to occupy the greater part of my time, particularly as I have to keep in view the increasing requirements of advanced and special students; but I hope that some research work will in time emanate from my laboratory now that, by the kindness of the School Committee, I have been able to engage an able volunteer, in the person of Miss Sophia Summers, M.A., B.Sc., one of the Carnegie scholars of the University of Aberdeen. Miss Summers began work, under my direction, on the 10th of October.

Finally, I may mention that the departmental museum does some small service to the cause of education in the way of small "loan exhibitions." One such exhibit is still at the Anglo-Japanese Exhibition, and one was on view at the annual meeting of the British Medical Association in July last.

A. ALCOCK,
Lieutenant-Colonel, I.M.S., retired.

Enclosure 2 in No. 3.

LONDON SCHOOL OF TROPICAL MEDICINE.

REPORT of the HELMINTHOLOGIST for the half-year ending 31st October, 1910.

SIR, London School of Tropical Medicine, Royal Albert Dock, E.

I HAVE the honour to submit my report for the half-year ending October 31st, 1910, and to forward a reprint* of a memoir on "The entozoa of the Hippopotamus," published in the Proceedings of the Zoological Society during the period.

My time has been wholly employed in teaching and in research in the special subject for which I hold my appointment.

Teaching.

(a) Four systematic lectures and a course of laboratory instruction extending over a period of three weeks were given in July. This course forms an integral part of the school curriculum in Tropical Medicine.

(b) An advanced course of practical instruction in medical helminthology, extending over three weeks, was held for students who had previously attended the ordinary course.

(c) The series of "Lectures to Nurses on Tropical Subjects" was suspended during the summer, but, by request, I gave my lectures on "Helminthiasis" to those nurses at the Seamen's Hospital in training for the Colonial Services.

(d) A special course of tuition in medical helminthology was provided for Captain Siler, of the United States Medical Service.

Research Workers.

Dr. A. Hutton, of the West African Medical Staff (Northern Nigeria: seconded), who had attended in previous sessions the ordinary and advanced courses in Helminthology, has occupied a table in the Research Laboratory for several weeks. He is engaged upon an investigation of the helminths of domesticated animals of Nigeria.

Lieutenant Atkinson, who was working in the Department last session, left with the National Antarctic expedition in May.

Reports, &c.

A large quantity of material has been received from various parts of the world. The whole of this material was examined on arrival, and preliminary reports were forwarded to the collectors. One notes with satisfaction that the bulk of the material is now sent by former students, and that, with rare exceptions, it is skillfully preserved.

In connection with my appointment I have been able to afford information and assistance upon helminthological matters to:—

- (a) Entomological Research Committee (Tropical Africa): Diagnosis of Specimens.
- (b) Board of Agriculture, Grouse Disease Committee of Inquiry: Development of Trichostrongyles.
- (c) Royal College of Surgeons Museum: Diagnosis of Specimens.
- (d) Sanitary Department, Government of Bombay: Dracontiasis, Prophylaxis.
- (e) Local Government Board: Nature of Onchocerciasis in Cattle.
- (f) Punjaub Veterinary College, India: Diagnosis of Specimens.

Arrangements for Post-Graduate Tuition in Veterinary Helminthology.

From time to time inquiries have been made by qualified veterinary surgeons for a course of practical instruction in veterinary helminthology. It appears that no such tuition can be obtained at the present time in Britain. An opportunity thus presents itself of turning to some practical use the collection of parasites of domesticated animals accumulated by the Department during the past six years. Provisional arrangements have now been made to hold a special course for veterinary surgeons at the London School of Tropical Medicine in November next. Should this new departure attract the interest and support of veterinarians at home and in the tropics it will, it is hoped, become a permanent feature of the work of the Department.

* Not reprinted.

Original Investigations.

The examination of the new material received for report absorbed so considerable a portion of the time unoccupied by teaching that it has not been possible to conclude and embody in a formal publication the special lines of investigation that have been followed. A series of experiments have been made during the summer vacation with a view to ascertaining a means of dealing with wells already infected with guinea worm in towns where it is impossible to close them permanently or for a lengthened period. The laboratory experiments point to a rapid and simple method of rendering confined waters, as met with in wells, innocuous and almost immediately potable.

Thanks to Dr. Newham, who brought back from his recent tour in British Guiana several fine specimens of *Filaria bancrofti* collected at the Bacteriological Institute, Georgetown, I have been enabled to make a detailed study of the anatomy of this important (but rarely found) nematode, and to elucidate the mystery of the number, disposition, and character of the genital papillæ in the male worm.

The anterior extremities of the type specimens of *Filaria perstans* and *Filaria demarquai* have been subjected to further scrutiny, and it appears that around the mouth in these species, as in *Filaria bancrofti*, two sets of tactile papillæ are present, four in each set.

It is impossible to pass over without special commendation the rich contribution with which Dr. Sells, of the Uganda Medical Service, has again supplemented his previous collections. A considerable amount of time has been devoted to the investigation of the enormous quantity of amphistomes of cattle we have received from him, and several new forms have already occurred. Dr. Connal, of Southern Nigeria, brought a valuable and perfectly preserved series of parasites obtained from various animals around Lagos, including some apparently new nematodes.

Lastly, Dr. Stanton and, through him, others in the Malay States, have again supplied us with valuable and little-known forms from that part of the world.

Helminthological Museum.

Material received during the half-year ending October 31st, 1910, from :—

Europe.—Drs. A. Hutton, J. F. Gemmill.

Asia :—

India.—Colonel Raymond, Captain Lane, Drs. Annandale, Woolliscroft, Mr. Gaiger.

Malaya.—Drs. Hennessey, Stanton, Symonds, Wellington.

China.—Drs. Bell, Preston-Maxwell, Macfarlane, Duncan Whyte.

Africa :—

Sierra Leone.—Dr. Burrows.

Lagos.—Dr. Connal Simpson.

Northern Nigeria.—Dr. Neale, Dr. Parsons.

Nyasaland.—Drs. Stannus, Pask, Old.

Uganda.—Dr. Sells.

Sudan.—Drs. Balfour, Christopherson.

Transvaal.—Dr. Turner.

America.—Dr. Minett, Dr. Newham, Professor Fulleborn.

Australia.—Dr. Strangman.

Bibliographical Work.

Little progress has been made in this direction since my last report. It is, I fear, becoming obvious that it will be impossible to continue this necessary adjunct to systematic work without official assistance.

I have, &c.,
ROBERT T. LEIPER.

Enclosure 3 in No. 3.

LONDON SCHOOL OF TROPICAL MEDICINE.

REPORT of the Protozoologist for the Half-year Ending October 31, 1910.

REPORT of Six Months' Work of the Expedition to Bagdad on the subject of Oriental Sore.

Bagdad was reached in the second week in March, and work was commenced as soon as suitable accommodation had been secured. There has been no lack of material, as it was soon found that the Oriental sore of Bagdad, known locally as the date boil, was a disease from which practically all inhabitants suffered at some period of their life. The vast majority of those infected, however, are very young children of from one to three years of age, and some time elapsed before a case suitable for the conduction of experimental work was found. The investigations so far conducted may best be described under the following headings:—

1. The characters and course of the disease in man.
2. The examination of lower animals for signs of the disease and inoculation of these from man.
3. Study of the various biting flies, ticks, &c., found in Bagdad.
4. Experiments with the biting flies fed on date boil cases and dissection of flies.
5. Examination of the date boil parasite as it occurs in the sore.
6. Culture experiments with the date boil parasite.

1. THE CHARACTERS AND COURSE OF THE DISEASE IN MAN.

As has just been mentioned, with very few exceptions all inhabitants are infected at some period of their life. Natives of Bagdad almost invariably contract the "date boil" when young, and between the ages of one and three. Newcomers from uninfected districts contract the disease most usually within the first twelve months after arrival, but in rare cases they may escape the disease for years, if not permanently. All classes of inhabitants are infected alike, and the scar left by the "date boil" and known as the "date mark" is to be seen on the face of nearly everyone. People living outside Bagdad—the Arabs in encampments and the dwellers in the smaller villages—apparently escape infection, as several cases have been encountered in young adolescents who have come into Bagdad later in life to find occupations.

Seasonal prevalence of the disease.—As is generally known, there is a seasonal prevalence of the disease. The "date boil" most usually makes its appearance in the autumn at the time when the dates are ripening. From this fact the name "date boil" is derived, and also one of the local theories which attributes the disease to eating dates or even to pricking by the thorns of the date palms. Such a theory cannot be entertained since the subjects most usually infected are little children who have hardly attained the age of eating dates. Though the disease most usually makes its appearance in the months of September, October, and November, the date boil may develop at any season of the year. This seasonal variation in the frequency of onset of the disease must certainly depend on a parallel variation in the occurrence of some biting fly responsible for its transmission.

Position of date boil on the body.—It has long been a recognised fact that the date boil appears only on exposed surfaces of the body. In very young children of about one year old one rarely sees a date boil except on the face. This is probably dependent upon the habit of wrapping up infants so that the whole body is covered except the face. In children a little older the date boil is commonly seen on the arms and legs below the elbows and knees, though the face is still the most usual situation. In adults, invariably newcomers, the disease appears almost as frequently on the arms and legs as upon the face. It is rare to find a date boil in any other part of the body. I have seen one case in a boy aged about five where there was one boil on the buttock and another on the chest over the sternal end of the second left rib. This practically constant appearance of the date boil on the exposed surfaces of the body can only be explained by the assumption that the disease is transmitted by some biting insect which feeds upon these exposed surfaces, in contradistinction to such biting insects as body lice, fleas, and bed bugs, which prefer to suck their blood under the protection of clothing.

Number of date boils.—It is probably safe to state that the single sore is most commonly encountered, and this one may be on the cheek, lip, nose, eyelid, forehead, arm, hand, leg, or foot. Two, three, and even four sores are by no means uncommon, but cases with larger numbers than these are certainly rare. I have seen one case where there were eighteen sores on the face, and one on each of the limbs, with the exception of the left arm, which had two, making a total of twenty-three sores. I have been told of cases where the numbers have been even greater, but the character of the sores in these cases had not been established by microscopical examination. The question may be asked: "Is it safe to assume that, in these cases of multiple sore, each sore is the result of a separate inoculation by some biting insect?" It may be answered that in this case of multiple infection there was not a single sore on an unexposed surface.

Incubation period.—On the subject of the incubation period it is difficult to obtain precise information. The youngest child I have seen infected was seven months of age. Cases of Europeans becoming infected within two months of entering the country are not uncommon, and I have obtained a reliable history of a case of two red spots appearing on the feet a fortnight after arrival. These persisted for upwards of a year, and in them I was able to find large numbers of the typical parasites. On the other hand, it is known that the disease may make its first appearance in a person many months after leaving the country. It is probable that the time elapsing between inoculation and the appearance of a visible sore is very variable, and may depend on several factors, such as a person's natural resistance to the disease and his general health at the moment of infection. The parasites may have been multiplying slowly in the skin at the point of inoculation, and have produced no visible reaction, or one which is so slight as to be overlooked. It is difficult to fix a point up to which the period of incubation is to be reckoned.

Recently I have attempted inoculation in human beings, but these experiments are not yet complete.

Character of the sore.—Locally it is believed that there occur two kinds of sore which are designated male and female. Clinically this is true. As the types of two extremes there exist the ulcerating and the non-ulcerating sores. The ulcerating, or as it is known locally, the female sore, commences as a red papule, the surface of which soon breaks down, leaving a shallow indolent ulcer from which a yellow fluid exudes carrying with it the typical date boil parasites and the numerous bacteria with which these ulcers become secondarily infected. The ulcer gradually extends till in very severe cases a large area may be involved. In one case encountered the ulcer occupied the whole of one cheek, had destroyed the lower eyelid of that side, and had extended across the bridge of the nose to the other cheek. When small these ulcers frequently scab over, but the scab is easily removed, and when left only serves to retain pus, and to make the sore painful. In these spreading sores one often finds that one part of the sore heals while it is still extending in another direction. When these ulcers heal they leave the superficial large scars known as the date mark, seen so commonly on the faces of the Bagdad inhabitants. It is very rarely that any deformity results from contraction of these superficial scars.

The male, a non-ulcerating sore, commences also as a papule of a characteristic reddish-brown colour, and covered with shiny epidermis. It increases in size very slowly, and shows very little or no sign of ulceration. A scaly scab may form at the centre of the date boil. This scab may fall off naturally or be removed, when there is again left the reddish-brown shiny skin beneath. On puncturing such a date boil one obtains a pure culture of the date boil parasite free from any admixture with other organisms. It is from such sores that the cultures to be described below have been obtained. At any time the centre of one of these non-ulcerating sores may break down and give rise to an ulcer, which may become secondarily infected and extend as the female sore.

Duration of disease.—The duration of the disease is usually about one year, with a variation of about three months on either side of this limit. The sore may remain as in the "male sores" without ulceration at any stage of its existence. It remains a papule which increases in size, becomes stationary, and finally shrinks till it completely disappears, leaving a reddish-brown colouration of the skin which gradually fades away. The scars left by these sores are never so deep as those of the ulcerating type, where infection with other organisms is a constant feature of the disease. The organisms found in the ulcerating sores are streptococci, staphylococci, various bacilli, and frequently a diplococcus resembling very closely the

gonococcus, in that it occurs in pairs within the pus cells. This latter organism I have found on several occasions in a subacute ulcer which frequently attacks people in Bagdad, and which might readily be confused with the true date boil. It is worth while remarking that on no occasion have I encountered spirochætes in the scrapings of these ulcerating date marks.

Immunity.—After the date boil has healed, the person is protected completely from further attacks. I have been told of persons who have had a second, and even a third attack, but if such cases occur they must be extremely rare. The consensus of opinion amongst the inhabitants of Bagdad is that a second attack is impossible, and the exceptions are so few that this opinion is substantially correct. Sometimes while a date boil is developing on one part of the body a second will begin at some other point perhaps six months after the commencement of the first. This merely shows that the immunity is not yet complete. In one case an Englishman suffered from a sore on the right wrist for about one year. It disappeared when a second sore developed on the left elbow and this lasted for another year. Some cases have been recorded of persons who have suffered from the Aleppo boil contracting the Bagdad boil on coming to this town. With these few exceptions the single attack lasting about one year is the rule, while the healing of the sore appears to be brought about by an immunity against the specific organism acquired by the person infected, such an immunity being of sufficient duration to protect the person from further attack for the rest of his life.

Treatment.—It is very doubtful if any treatment at present attempted has been of avail. Excision of the sore has been attempted and with success, but such a procedure would probably leave the patient non-immune and open to further attacks. Various ointments and lotions have a certain reputation in Bagdad, but they do little or nothing to lessen the duration of the disease. I have been giving the yellow mercury ointment of the B.P., and some have declared it to have produced a cure in a few days. The majority of the people are very dirty, and as I insisted that before the application of a fresh supply of ointment to the sore, the old ointment must be carefully washed off, this treatment at least has had the virtue of keeping the sores clean, and in this way alone may have been of benefit.

Symptoms.—Apart from purely local symptoms due to the sore it is impossible to trace any constitutional disturbance. The fact that nearly all sores are in very young children makes the selection of such symptoms difficult, as any slight disturbance in health can at this age be attributed to the common ailments of childhood. Again, the onset of the disease is so insidious that the appearance of the first papule is not considered to be a date boil, till by its persistence the patient recognises its nature. Slight fever, feeling of malaise or intestinal derangement, which might be due to the infection with the organism of the date boil, would most probably be looked upon as one of those slight disturbances so common in all hot countries. In the case mentioned above, of the child with twenty-three sores, there was nothing to indicate, apart from the sores, that the child was in any way abnormal. The child was well developed and well nourished, and showed every sign of enjoying life completely. It has been suggested that this disease is a general one, and that the sore is merely a local manifestation of a general infection, as in the case of the syphilitic chancre. If this be true there is, however, this difference: whereas the chancre in syphilis indicates a very severe general infection accompanied by various symptoms, the date boil is accompanied by no such constitutional disturbances or such as are too slight to be detected.

The impossibility of performing autopsies in Bagdad is a misfortune, as from this source much light might be thrown upon the disease. Repeated examinations of the blood of infected persons have failed to confirm the observation of Newmann that parasites may occasionally be found in the peripheral blood. Likewise the attempts made to obtain cultures from the peripheral blood have met with no success. These observations and experiments are still being continued.

The local symptoms are due to the presence of the sore. As a rule there is little accompanying pain, and the sores are not remarkably tender. Occasionally where the sore has formed over a bone, as the tibia or on the elbow, the sores are tender and painful, but this is the exception. The discharge from the ulcerating sores is often very foul and exceedingly unpleasant, not only for others, but for the patient himself, who frequently is unable to remain in a room, but has to seek refuge in the open air. The painlessness of the date boil is well illustrated by the case of a man who had two on the foot for about one year. In spite of the sores he was able to

wear his ordinary footwear, to walk, ride, and take other forms of exercise without inconvenience.

I am unable to give any information as to the occurrence or otherwise of Kala Azar in Bagdad. The staff of the English medical mission at Bagdad have not met with the disease. If the disease occurs it has not yet been diagnosed as such. I have seen several cases with enlarged spleens and livers apparently not malarial. It is possible that some of these may have been Kala Azar, but a blood examination alone did not throw any light on the condition.

2. EXAMINATION OF LOWER ANIMALS FOR SIGNS OF THE DISEASE AND INOCULATION OF THESE FROM MAN.

Dogs.—The commonest domestic animal living in close association with man in Bagdad is the dog, which lives upon the refuse of the houses thrown out upon the streets. There is a general opinion that the dogs suffer from the date boil about the nose. Cases of dogs with these supposed sores on the nose have been difficult to find, and were not nearly so common as they were supposed to be. Several cases were, however, discovered, but unfortunately in none of these could the parasite be found. One large dog had an ulcerating condition of the legs which had been regarded as date boil, but repeated examinations of this have failed to reveal the parasite. All these cases were in pet dogs living in private houses. Examination of a large number of street dogs has shown that ulceration about the nose is very uncommon amongst them though they often have wounds on the head the result of their constant fighting.

Quite recently the authorities in Bagdad have followed the example of Constantinople in taking steps to exterminate the dogs from the streets. Accordingly all street dogs have been collected and herded together in an enclosure in the desert where they are kept in a condition even less sanitary than that in which they lived before. These dogs are dying off rapidly, and I have obtained permission to perform autopsies on the dead dogs. Up to the present I have examined the organs of about eighty dogs, and at the same time have kept a careful look out for any sign of date boil. I have not been able to find the parasite of the date boil in a single instance, so that if the dog acts as an alternative host for this parasite, it is only a very small percentage of dogs that is infected. Further, if it be true that the dog acts as a kind of reservoir for the parasite which is handed on to man by some biting fly, then the incidence of date boil amongst the population of Bagdad should considerably diminish now that all the street dogs have been removed. Time alone can give the result of this experiment.

Nearly every dog examined is found to harbour a hæmogregarine in its leucocytes, and the reproducing forms are constantly present in the spleen and bone marrow.

Piroplasmosis is common, occurring in perhaps 5 per cent. of the dogs.

The dogs are covered with ticks and fleas, and also a fly belonging to the Hippoboscidae. All of these will draw blood from man, the latter, however, rarely.

Cats.—Cats in Bagdad, like the dogs, live in semi-domestic condition. I have not been able to examine more than one of these animals, and the result of this examination was negative.

Rats.—Rats are exceedingly common and a great pest. Examination of numbers of these has only revealed the common *Trypanosoma lewisi* and the Hæmogregarina occurring in the leucocytes.

Inoculation of numbers of rats with date boil material has given no result.

Rabbits.—Similar experiments conducted on rabbits have likewise failed to give any result.

Birds.—Sparrows and two small owls have been inoculated without success.

Ticks.—An attempt has also been made to obtain a development of the parasite by inoculating the large blown-out ticks taken from dogs. The ticks survived the operation of inoculation, but no trace of any development of the parasites could be found.

Other domestic animals in Bagdad are the horse, mule, donkey, and cattle. Camels are rarely seen in the town, and then only in passing through the town from one gate to another. They are always left without the town in the desert. It is

unlikely that any of these animals have any influence on the disease as it occurs in Bagdad.

The failure to obtain an animal suitable for inoculation experiments has proved a great obstacle to the work. With an animal reacting easily to inoculations, as so many animals do to pathogenic trypanosomes, the work would be much simpler, whereas now experiments with flies can only be tested by dissection and search for developmental forms of the date boil parasite, a procedure which is much more difficult and full of pitfalls than the experiment of transmission.

3. EXAMINATION AND DISSECTION OF FLIES AND TICKS.

Biting flies.—Before naming the true biting flies some remarks must be made of the common house fly which, as would be expected, occurs in myriads. It is constantly swarming over the faces of the children, and especially those made attractive by the presence of the date boil. From an examination of the flies taken off the sores I have demonstrated that the parasites are being continually taken up, and are to be easily found in the gut directly after feeding. It must certainly come about that the house fly acts on occasions as a simple carrier of the disease to open wounds. Only in this way can be explained some of the cases in which wounds incurred upon the face, arm, and leg have ultimately developed into date boils. Or as sometimes happens, the wounds completely heal, and later a date boil develops at this spot.

Stomoxys.—From the time of my arrival in Bagdad in March till the hot weather had set in in June, these flies occurred in fair numbers, especially in the neighbourhood of the stables. They often settled upon one and were mistaken for ordinary house flies till the pricking of their proboscis revealed their nature. They would frequently bite through socks. With the advent of the really hot weather these flies almost disappeared, and could rarely be discovered even in the stables, their favourite haunt. These flies feed normally upon the horses, mules, and donkeys.

Hippoboscidae.—Flies belonging to this group are to be found commonly on the horses. Another is seen constantly on the dogs, where it hides buried in the fur till disturbed, when it leaves its host or flies to hide on some other part of the body. These flies will sometimes bite human beings, but this is a rare occurrence. I have been bitten only on two occasions, though I have been living in close association with a number of dogs all of which had many of these flies about them.

Tabanidae.—Flies of this genus, *Tabanus*, I have not encountered in Bagdad, but I have seen one taken a mile or two out of the town.

Fleas.—Fleas are a great pest, and especially at a certain season of the year, which is popularly known as the flea season. The season is the month or two before the commencement of the summer or season of intense heat. They are constantly on one's person, and give one no rest. With the hot weather they completely disappear.

Body lice.—These are found commonly on the bodies and clothes of the dirty part of the population of Bagdad.

Ticks.—Ticks are found on practically all the domestic animals. They, however, rarely attack man. The dogs in the streets are usually covered with them.

Bed bugs.—Bed bugs occur in Bagdad, but in no great numbers. They can usually be obtained fairly easily in the prison, where they hide in the mats used to cover the floor, or upon which the prisoners sleep. In only one other house have I heard of the occurrence of bed bugs, and then only in small numbers. It is certain that Bagdad is not infected with bed bugs to anything like the extent of some other Eastern cities. It is possible that the dryness of the atmosphere, combined with the intense heat, is unfavourable to their development.

Sand flies.—Sand fly is a name used here for any small fly that bites at night. I have not encountered a true sand fly in Bagdad. The fly usually described by this name is a *Phlebotomus*. It is able to pass through the meshes of the mosquito net, from which it escapes in the morning after feeding. I have only been able to secure very few of these flies, as they are exceedingly difficult to capture.

Mosquitoes.—These occur in large numbers. In those years that the river overflows its banks and runs into the desert around Bagdad forming pools and marshes the mosquitoes are said to occur in greater numbers than I have seen. Before the hot weather has set in, from March to June, various species of *Culex* were very common. Amongst these was the common *Culex fatigans*. The other species have not yet been identified. With the advent of the hot season the number of *Culex*

began to diminish while another mosquito, *Stegomyia* sp., increased in numbers. This mosquito lives in the houses and hides in any dark corner, especially the sir-darbs, or semi-underground rooms, into which one retires at the hottest part of the day. The *Stegomyia* is most persistent in its attack, and is a constant worry during the day. Both the male and female suck blood, but the females more vigorously. A female mosquito will readily feed every day, and forty-eight hours appears sufficient time for the digestion of the large quantity of blood taken at a single feed. During the hot weather these mosquitoes have increased in numbers till at the present time they are at their maximum. They breed, as do other mosquitoes, in the wells and "hubs" or native filters of porous earthenware found in every house in Bagdad. During the hot weather the growth is very rapid, and one week is almost sufficient for the complete development of the mosquito from the egg.

Dissection of, and experiments with, flies, ticks, &c.—The ordinary house fly commonly harbours the flagellate *herpetomonas* in its gut. It is difficult to give any definite percentage for infected flies as the number of infected individuals in different batches varies considerably. It is possible that more than one species of *herpetomonas* is to be found in the house fly. A *Crithidia* was found on several occasions to inhabit the malphigian tubes. As mentioned above, these flies constantly feed on the date boils, and the parasites can be demonstrated in the gut soon after feeding. So soon as six hours after feeding on the sore I have failed to detect the parasite in the gut. A large number of experiments have been conducted to trace any development of the date boil parasite in the flies' gut, but without success. Two series of flies, consisting of ten each, were fed in the following way:—

One series was allowed a daily feed of fresh human blood, the second series was fed on the scrapings of a date boil. After ten feeds in this manner the flies were dissected. The result was that in those that had fed from the sore no trace of the date boil parasite or other flagellates could be detected, while amongst those that had fed upon human blood one had a *Herpetomonas*, probably *H. musca domesticae*, in its gut. From this and other experiments it appears that the date boil parasite does not develop in the house fly. I have not been able to determine whether the parasite is passed unharmed through the gut of the fly. Examinations of the excreta have given no definite result.

Stomoxys feed readily off the sore each day, but the results of such feeds have been negative. This fly occasionally harbours a *Herpetomonas*, evidently a parasite peculiar to itself.

Large numbers of the dog fly (*Hippoboscidae*) have been dissected, but no flagellates were found in them. It was impossible to keep these flies in captivity, nor could they be induced to feed from the date boil. A dissection of the fleas and body lice have likewise given no result in the way of a flagellate infection.

With bed bugs obtained from the prison experiments were made. The bugs were allowed to feed upon the sore, and were dissected at varying intervals after feeding as had been done in all feeding experiments. In a certain number of these, flagellates of the *Herpetomonas* type were found in the gut forty-eight hours after feeding.

The resemblance of these flagellates to the cultural forms of the date boil parasite is my clue, and since a dissection of a considerable number of bugs, which had not fed on the sore, has failed to reveal any flagellate infection, it is probable that this *Herpetomonas* represents a culture of the date boil parasite in the gut of the bed bug. The distribution of the bed bug in Bagdad is so restricted that it is impossible for it to be the true carrier of the date boil. It is more probable that the large quantity of blood taken into the stomach had served as a good culture medium in which the date boil parasites were able to develop.

This observation is very similar to that made by Patton on the development of the parasite of kala azar in the same insect. If the parasite of the date boil can develop into a flagellate in the stomach of an insect, not its true host, then it would be expected that the very similar parasite of kala azar would develop in the same manner. Such experiments and results only show that it is unsafe to draw the conclusion that an insect showing such developmental stages is the true carrier of the disease. The development is probably merely a partial imitation of what would actually take place in the true intermediate host.

A large number of experiments have been conducted with mosquitoes, which in nearly every instance have been hatched in the laboratory. With the various species of *Culex* there was no result. It was exceedingly difficult to induce them

to feed upon the sore, and it was only rarely that one would feed more than twice. However, a sufficient number were experimented with to show that no development of the date boil parasite was to be traced in them. With *Stegomyia* the feeding was much simpler. They fed readily in broad daylight, and were eager to feed upon the sore every day. It was determined that these mosquitoes had taken up parasites by dissections made immediately after feeding. These mosquitoes were allowed a varying number of feeds, and dissected as a rule 24 or 48 hours after the last feed. A large number of experiments have been conducted, and in four instances have *Herpetomonas* been found in the mid gut. These bear a close resemblance, as in the case of the bed bugs, to the cultural forms of the date boil parasites. The hind gut was in every case free from flagellates, and this fact is perhaps in favour of these flagellates being derived from the parasites taken up at the feeds, for as a rule an insect having a natural flagellate infection has the infection limited entirely or most marked in the hind gut. It is very difficult to obtain a definite proof that these flagellates have developed from the date boil parasites. Up to the present *Stegomyia* fed on human blood free from parasites have failed to reveal any flagellates on dissection. The examination is still in progress.

All these feeding experiments have been conducted upon a case of date boil in a boy. The sore was of the non-ulcerating type, and covered with thin red skin. Puncture of the sore gave a pure culture of the specific parasite free from any other organisms.

Very commonly a Gregarine is to be found, in the encysted and spore stage, within the malphigian tubes of the *Stegomyia*. The complete life-cycle of this Gregarine has been traced. The free Gregarines live in the intestine of the larvæ where they are seen hanging from the endothelial cells. As the larva changes to the pupa so the Gregarines migrate into the malphigian tubes, and commence encystment in pairs. By the time that the mosquito emerges from the pupa the complete development has taken place, and the characteristic spindle spores are to be found in the malphigian tubes. Evidently these spores escape into the water and re-infect the young larvæ with their food.

Occasionally the larvæ of *Stegomyia* sp. have an infection of *Herpetomonas* in the malphigian tubes. It is possible that the flagellates found in the mid gut of the adult mosquito after feeding on the date boil are derived from these. However, no case of flagellate infection of the pupa has yet been met with, though very many have been dissected.

The gut of the larvæ is almost always teeming with spirochætes.

Unfortunately, up to the present it has been impossible to secure sufficient specimens of *Phlebotomus* for experimental work.

Character of the parasite as found in the sore.—The parasite in smears from the sore varies very much in size and shape from the classic oval parasite with the deeply staining rod and paler nucleus. The typical oval parasites are found in large numbers, but in addition to these are many smaller forms occurring mostly outside the cells. As Dr. Row has figured them they are frequently pointed at one end, while the micro-nucleus lies close against the macro-nucleus. In the pointed forms the micro-nucleus is almost invariably on the side away from the pointed extremity, a fact which seems to indicate that this pointing is not a stage in the direction of flagellum formation as one is inclined to suppose. The protoplasm of the body of the parasite is usually vacuolated, while the fine red staining line running from the micro-nucleus to the surface of the body is often seen, especially in the larger forms. This red line is without doubt the rhizoplast, root, or intra-protoplasmic part of the flagellum. I have not been able to trace any change undergone by the parasite with the growth of the sore. All forms are to be found in both young and old sores. Parasites without nuclei, or with only a micro-nucleus or macro-nucleus, are frequently seen. These are probably degeneration forms. The case of admixture with other organisms in the ulcerating sores has been mentioned above. As is well known the parasites, when intracellular, are found in the large micro-nuclear cells which are often full of parasites, and have their nuclei broken up by this invasion. When other organisms are present, and there is a purulent discharge, the parasites are taken up by the polymorphonuclear leucocytes.

Culture of the parasite.—The parasite has been successfully cultivated on several occasions. The first attempt was made with a medium prepared after the formula of the rabbit blood agar of Novy and MacNeal with the difference that dog's blood was substituted for the rabbit's blood. After several failures, due to contamination, a successful result was obtained from a boil on a child's face. Sub-

cultures were made from this upon rabbit blood agar and dog blood agar. Development in the rabbit blood medium was much more rapid, and on this the culture was maintained for several months. The cultures upon the dog's blood medium eventually died out. The development of the parasite followed closely the description given by Dr. Row of the cultures of the parasite of Oriental sore.

Inoculation of these cultures into various animals has given no results. The parasites, both in smears of the sore and from cultures, have been stained by various methods. Giemsa's method of wet fixing and staining has been tried, and films have been fixed in Schaudinn's fixative and stained with Haidenhain's hæmatoxylin, and also with ordinary alum hæmatoxylin. Both in the parasites from the sore and from the cultures the nucleus was found to have a structure very different from that appearing on films stained by the drying methods. The nucleus consisted of a spherical or oblong body limited by a delicate membrane. At the centre of this is a deeply staining karyosome appearing red by Giemsa's method and black after Haidenhain's hæmatoxylin. The nucleus of this parasite is, therefore, constructed on the same lines as the nuclei of the trypanosomes. In nuclear division the karyosome first divides by becoming elongated and finally constricted at the centre. The micro-nucleus stained as a round or rod-shaped body surrounded by a pale area. The flagellum in the flagellated forms was traceable to a point close to the micro-nucleus, but it does not unite with it.

In multiplication by division the flagellum of the divided-off parasite appears to be a new formation growing out from the karyosome, and is not formed by splitting of the already existing one.

Origin of the disease.—There are many local theories explaining the origin of the disease. Some maintain that it is only those who drink the water of the Tigris or Euphrates who become infected, others that it is due to the contamination of open sores by dust from the roads, while some believe it to have some kind of relationship to syphilis. The names "date boil" and "date mark" are the result of another theory attributing the disease to the dates which become ripe just at the season of maximum incidence of the disease. None of these theories will explain the disease. On account of the peculiar distribution of the sore, the character of its parasites, and the development of this into *Herpetomonas* in the culture tube, the only tenable hypothesis is that some biting fly transmits the infection. The possibility of the house fly acting as a mechanical carrier of the disease has been mentioned above. That this mechanical transmission is to be regarded as the normal means of infection cannot be maintained. That it can act in any other way than a mechanical carrier is disproved by the failure of the parasites of the date boil to develop into flagellates in their intestines, and the quick disappearance of these when taken up from the sore. These statements are, of course, based on the assumption that the culture one obtains in the test tube is at least a picture of what is to be found in the intestine of the true intermediate host. That this is probably correct is borne out by the fact that a partial development will take place in the intestine of the bed bug.

The *Stomoxys* as the carrier of the disease is not to be suspected, as it not only is limited to its distribution, occurring, as already stated, mostly in the neighbourhood of the stables, but it also fails to give any development of the parasite in its gut even after as many as ten feeds from the sore.

The bed bug, on account of the development of the kala azar parasite taking place in its gut, and its supposed responsibility for the spread of this disease, was at first looked upon with suspicion. It was soon found that its distribution in Bagdad was too limited to account for the disease; and further, it would not explain the occurrence of sores only upon exposed surfaces of the body. In spite of the impossibility of the bed bug being the host of the date boil parasite a certain development of the parasite takes place in its gut. This observation is of great importance, as it shows that the development of the kala azar parasite, which was found by Patton to take place in the same host, may be of a similar nature. The evidence of such a development is insufficient to prove the bed bug the intermediate host. There is a possibility, in my experiments as well as in Patton's, that the flagellates seen in the bed bugs are parasites peculiar to these insects. A dissection of numbers of bed bugs which have not taken up date boil parasites has at least tended to disprove this view. It seems, therefore, that the large quantity of blood taken up by these insects when they bite is able to act as a culture medium for these parasites, without this culture indicating in any way that the development is the true development in an intermediate host.

The Hippoboscidae, the ticks, the fleas and body lice will not explain the disease. The two former on account of their seldom attacking man, and the two latter because they would give rise to sores more frequently on the unexposed rather than on the exposed surfaces of the body.

The only other biting flies of any note in Bagdad are the mosquitoes and the so-called sand flies. Of the mosquitoes only the *Stegomyia* can be suspected. In the various species of *Culex* no demonstrable development of the parasites has taken place. On the other hand various facts would point to the *Stegomyia*. This mosquito is essentially a house mosquito, and is most persistent in its attempts to obtain a feed of human blood. When it has completed its fill of human blood it quickly digests this apparently enormous quantity, and is ready on the next day for another feed. It bites as readily by day as by night, so that one is never free from its attacks. Further, with the commencement of the hot weather this mosquito increases in numbers till at the present time—at the end of September—it is at its maximum. This corresponds with the season of maximum prevalence of the date boil which, as before mentioned, is in the month of October. In addition to this evidence in a certain number of these mosquitoes fed from the date boil flagellates have been found in the stomach forty-eight hours after feeding. It is not quite certain that these represent developmental stages of the date boil parasite, and even if they do their numbers and character resemble the condition found in the bed bug, and is not the extensive development one would like to find. However, experiments of transmission with this mosquito have been done upon a resident in Bagdad who has not yet suffered from the date boil. It is still too early for any result. It would thus appear that there are many points in favour of regarding the *Stegomyia* sp. as the transmitter of this disease, and if it were not for the presence of the sand fly (*Phlebotomus*) the evidence would be still greater. This small fly attacks during the summer months, but has not been secured in numbers sufficient for experimental work. It bites especially on the roof at nights, where all Bagdad inhabitants sleep during the hottest weather. I am unable to give any facts in support of this fly being the host. It has been suspected in other places where this disease occurs. In Bagdad, however, in numbers and ferocity it does not approach the *Stegomyia*. This, however, is no evidence for or against its accusation. Efforts are now being made to obtain these flies in larger numbers, and it is hoped that the question will be settled by feeding experiments.

During the six months occupied in these investigations I found Mr. Stremes, my assistant, invaluable. Though he fared badly in the intense heat of the summer months, he was always ready and willing to give his help and assistance; and it is with much regret that I have to record his sudden death, due to an accident that took place in the laboratory during my temporary absence.

C. M. WENYON.

October 2, 1910.

APPENDIX V.

Reports from the Liverpool School of Tropical Medicine.

No. 1.

THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received May 10, 1910.)

SIR,

B 10, Exchange Buildings, Liverpool, 9th May, 1910.

As requested, I have the honour to enclose, for the information of the Tropical Diseases Advisory Committee, the following reports of the Liverpool School of Tropical Medicine for the six months ending 30th April, showing the manner in which the Government Grant to the School has been expended, viz. :—

- (1) Report of the Walter Myers Lecturer of the School (Dr. J. W. W. Stephens).
- (2) Report of the Director of the Runcorn Research Laboratories of the School (Dr. Warrington Yorke).

(3) Report of the Lecturer in Economic Entomology and Parasitology (Mr. R. Newstead).

I also enclose report by Professor Ronald Ross (Sir Alfred Jones Professor of the School), showing the work which has been done in connection with the special grant of £900 made to the School by the Tropical Diseases Advisory Committee in December last.

I am, &c.,
A. H. MILNE,
Secretary.

Enclosure 1 in No. 1.

REPORT OF THE WALTER MYERS LECTURER.

SIR,

May 9th, 1910.

I BEG to submit the following report on the work done during the period from November 1st, 1909, to 31st April, 1910.

Students.

The number of medical men who attended the Autumn term was 20, and the number for the Lent term 12. Total 32. This number includes members of the Royal Army Medical Corps, Indian Medical Service, West African Medical Staff, Colonial Medical Service, &c.

Diploma of Tropical Medicine.

The number of candidates who entered for the examination in December was 17, of whom 14 passed. The number of candidates for the April examination was 12, of whom 10 passed.

Museum.

The thanks of the School are due to the following gentlemen for their kindness in sending specimens to the School during the last six months :—

Dr. H. Wolferstan Thomas, Expedition to Manaos, Brazil; Dr. K. S. Wise, British Guiana; Dr. Davey, Rhodesia; Major Donovan, I.M.S., Madras; The School of Medicine, Cairo; Dr. Ferguson, Cairo; Mr. R. E. Montgomery, Nairobi, British East Africa; Dr. Conor, Tunis; Major Leonard Rogers, I.M.S., Calcutta; Major Clayton Lane, I.M.S., India; Dr. Bell, Hong Kong; Captain Christophers, I.M.S., Kasauli; Dr. Critien, Malta; Dr. R. H. Kennan, Freetown.

Research Work.

During the winter 1909-1910 I had the privilege of working in Professor Loos's laboratory at the Kasr-el-Ainy Hospital, Cairo. While there I worked out the description of a new genus of the Trematoda based on specimens taken by my colleague, Mr. R. Newstead, from a Nicaraguan tortoise. I hope shortly to complete the description of this fluke. I was able, in my spare time, to make a small, but good, collection of specimens for the museum.

On the way home I visited Ismailia to personally inspect the anti-malarial operations carried out there; and have in preparation a detailed account, with plans, of the work actually done.

Trypanosoma gambiense.—During the class work in March, 1910, I observed some morphological peculiarities in this strain maintained at the Runcorn Research Laboratories, which was derived from a case of sleeping sickness now under treatment at Liverpool. To eliminate error, I myself made fresh animal inoculations from this case. A further examination showed that these peculiarities were non-existent in another strain of *T. gambiense* maintained at Runcorn. Owing to great pressure of work, I asked Dr. H. B. Fantham to assist me in describing these forms, and we hope to publish immediately a paper on this subject. The question that has arisen out of this observation is the following: Is this trypanosome, with certain morphological characters so marked that we think we can always distinguish the two strains in blood films, a different species from *T. gambiense*? Whatever be the answer to this question, the peculiar morphology of this trypanosome has seemed very worthy of being recorded.

Japan-British Exhibition.

At the request of the Science Committee of this Exhibition the School authorities decided to display a scientific exhibit, and entrusted its preparation to Mr. Newstead and myself. The educational character of the exhibit is the feature which we have mainly borne in mind—considering the popular character of the exhibition. Specimens have been shown illustrating how some of the principal parasitic worms are contracted; and the mode of infection is explained by illustrations and specimens in the following diseases: Bubonic plague, malaria, yellow fever, sleeping sickness, tick fever, and myiasis.

I have, &c.,
J. W. W. STEPHENS.

The Secretary,
Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

Enclosure 2 in No. 1.

DEPARTMENT OF THE DIRECTOR OF THE TROPICAL RESEARCH LABORATORIES,
RUNCORN.

SIR,

As requested, I have the honour to report in brief on the manner in which the Government grant has been expended, and on the work done in the Runcorn Research Laboratories of the Liverpool School of Tropical Medicine from November 1st, 1909, to April 30th, 1910.

The grant has been mainly utilised for defraying the current expenses of the laboratory, for the purchase and maintenance of experimental animals necessary for the preservation of the various strains of trypanosomes and other protozoa required for teaching purposes, and for carrying on research work in the laboratory.

Dr. J. B. Murphy was appointed assistant at the beginning of February.

Dr. Yorke continued his investigations regarding the variation of the hæmolytic complement in experimental trypanosomiasis. He has been able to demonstrate that in most cases of experimental trypanosomiasis a marked diminution, or total disappearance, of the hæmolytic complement occurs for a few hours before the animal's death. No decrease of the hæmolytic complement was observed in the earlier stages of the disease, even when the blood of the animal was swarming with trypanosomes, and, finally, the serum of an animal in the last stages of the disease, at a time when it contains no hæmolytic complement, has no inhibiting effect on the activating power of the complement of normal serum.

Yorke and Murphy have continued their investigations on the therapeutic action of trypanblue in dogs infected with *Piroplasma canis*. The fact that they were unable to save any of the first series of animals by treatment with trypanblue was probably due to the extreme virulence of the strain used by them; in nearly every case the animal died on the third or fourth day after inoculation. Pups of from six to twelve months old were used, and in each case the animal was inoculated intraperitoneally with 1 or 2 ccs. of heavily infected blood. In later experiments, in which the animals were inoculated subcutaneously, the disease ran a longer course of from eight to twelve days in the untreated dogs, and in these animals they were able to demonstrate that the drug exerted a distinctly beneficial effect.

Dr. Yorke has continued his work on the protective action of the serum of animals, either in a state of chronic infection, or immune to, various kinds of trypanosomes.

The following papers on work done in the laboratory have appeared since November 1st, 1909.

Life History on *Trypanosoma lewisi* in the rat louse (*hæmatopinus spinulosus*), by Breinl and Hindle. *Annals of Tropical Medicine and Parasitology*, Vol. III., No. 5, March, 1910.

Ueber den Mechanismus der Entstehung der Hämoglobinurie bei Infektionen mit *Piroplasma canis*, by Barratt and Yorke. *Zeitschrift für Immunitätsforschung und experimentelle Therapie*, B IV., December 28th, 1909.

On the variation of the hæmolytic complement in experimental trypanosomiasis, by Warrington Yorke; *Annals of Tropical Medicine and Parasitology*, Vol. III., No. 5, March, 1910.

I am, &c.,
W. YORKE.

Director of the Runcorn Research Laboratories.

The Secretary,

The Incorporated Liverpool School of Tropical Medicine,
Liverpool.

Enclosure 3 in No. 1.

DEPARTMENT OF MEDICAL AND GENERAL ECONOMIC ENTOMOLOGY.

SIR,

9th May, 1910.

I BEG to submit the following report for the half-year ending April 30th, 1910.

Students.

The usual courses of instruction in medical entomology were given, and a special course of lectures and demonstrations were also given to the students attending the Post Graduate course of Veterinary Hygiene.

Papers published.

1. On Two new species of African Coccidæ. *Journal of Economic Biology*, Vol. IV., pp. 18-22, 1910, with seven figures in the text. (Copy of this paper submitted herewith.)*

2. On Scale Insects (Coccidæ), &c., from the Uganda Protectorate. *Bulletin of the African Entomological Research Committee*. Colonial Office, Vol. I., pp. 63-69, 1910. This paper deals with several insects of economic importance; including a new species of *Stictococcus* affecting cacao pods.

Papers in the press awaiting publication.

1. A Report on the Mosquitoes of Manaos and Iquitos, joint with Dr. H. Wolferstan Thomas. *Annals of Tropical Medicine and Parasitology*, Vol. 4, No. 1, 1910. With one coloured plate, and one map.

This paper deals with the Bionomics of several South American mosquitos; and includes also the description of a new species of *Mansonia*. (A copy of the MSS. and plate submitted herewith.†)

2. On a collection of Coccidæ and Aleurodidæ, chiefly African. In the Collection of the Berlin Zoological Museum.

With the exception of four species of Coccidæ collected at Yap, Karoline Islands, this collection was made in German East Africa. It comprises in all 39 species, of which 32 are members of the Coccidæ and seven of the Aleurodidæ. Out of this total, 16 species are new to science and also to the African Continent, and there are two additional species which have not hitherto been recorded from this region.

3. On a collection of African Coccidæ from the Berlin Zoological Museum; collected in South and South-West Africa by Dr. L. Schultze.

This paper deals with eleven different species, of which eight are new to science. Some of these are of economic importance.

4. Some West Indian Insect Pests, affecting Cultivated Plants in Jamaica. Paper read before the Royal Horticultural Society, London, on December 1st, 1909. (Copy of circular enclosed.†)

Identification of Blood-sucking Flies and other Insects of Economic Importance.

In addition to the material dealt with in the various papers herein recorded, a large number of insects, including Blood-sucking Diptera and agricultural pests

* Not reprinted.

† Not printed.

have been identified for medical students, planters, and others in various parts of the world. These may be tabulated as follows:—

India: 23 species, chiefly mosquitos.

West Indies: 28 species, chiefly Coccidæ.

South America, British Guiana: 16 species of Tabanidæ; 2 species of Simulium (sand flies); 7 species of Robber Flies (Empidæ); 2 species Muscidæ from three cases (two fatal) of Myiasis.

South America, Amazon Region: 15 species of mosquitos, 2 of Tabanidæ.

Federated Malay States: 9 species of mosquitos.

Fiji Islands: 2 species of Tabanidæ.

Africa, Nyasaland Protectorate: 16 species of Tabanidæ and other biting flies, including 3 species new to science, and 2 species of Glossina.

Africa, Zambesi: 30 species of Tabanidæ including four that are new to science.

China: 3 species of biting flies, Tabanidæ, &c.

England: A species of Chermes (Aphididæ) affecting pine-trees recently imported from Japan. (Board of Agriculture and Fisheries.)

Species of Chermes from the Royal Botanic Gardens, Kew.

Plankton, &c., from the Liverpool water supply.

Mosquito Prophylaxis.

A set of illustrated post cards* has been prepared for circulation in Manaos, State of Amazonas, copies of which are submitted herewith.

Museum and other Exhibits.

A considerable amount of time has been given to the preparation of an exhibit for the Japan-British Exhibition, which has now been displayed in the Science Court at Shepherd's Bush. The preparation of the exhibit is the joint work of Dr. J. W. W. Stephens and myself.

I have, &c.,

ROBT. NEWSTEAD.

The Secretary,

Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

Enclosure 4 in No. 1.

REPORT OF PROFESSOR R. ROSS, F.R.S., C.B.

At its meeting on the 24th November, 1909, the Advisory Committee allotted to this School, at my suggestion, funds for the following lines of work: (a) for a descriptive bibliography of malaria; (b) for research work on cases of malaria treated in Liverpool; (c) for a chemist for research work; and (d) for researches on amœbic dysentery. The Committee of the School placed all this work under me; and I now beg to submit a brief report upon what has been done up to the 30th April, 1910.

(a) A polyglot clerk, Mr. W. Drawz, was appointed on the 1st December, 1909, for the bibliography. The literature of malaria is in Ancient Greek Latin, Italian, French, German, English, Spanish, Portuguese, Dutch, Russian, Modern Greek, and Japanese—twelve languages. Mr. Drawz, who can read more than half of these, has been continuously employed in making a general card index of the literature, with divisions under appropriate headings, and drafts, résumés, or notes of some of the more important papers. The literature ought to be fairly well classed in three or four more months.

(b) David Thomson, M.B., Ch.B., Edinburgh (with first class honours) was appointed to carry on the researches on malaria from the 1st January, 1910; and I decided that he should work at once on the numerous cases of malaria occurring in the tropical ward of the Royal Southern Hospital—material which had long required further investigation. I wished him also at once to commence the study,

* Not reproduced.

by the use of what I call enumerative methods—that is, methods which are used in making accurate counts of the parasites with a view to detecting correlation between their numbers and various clinical phenomena. He at first developed methods based upon the thick-film process suggested by me seven years ago, and after some initial trouble we were able to elaborate one in which most of the error of observation occurring with the ordinary rough methods of counting now in use were avoided.

In all, 23 cases of malaria have been carefully taken; charts showing the daily number of their parasites per c. mm. of blood, the number of their leucocytes, their temperature, and other reactions, presently to be noted, having been prepared.

The results obtained were immediate, many interesting points having been elucidated during the short time the work has been carried on.

One case was kept under observation for 40 days, and suffered from two relapses besides the original illness at exact intervals of ten days. It has long been a question what happens to the parasites between the relapses, as, by the rough methods of diagnosis in use, the parasites during such intervals generally become too few to be found. Many of the older writers have suggested explanations, and F. Schaudinn recently proposed that the relapses were due to parthenogenesis of the sexual forms. Dr. Thomson's accurate counts, however, show that the ordinary asexual forms are to be found throughout the apyrexial periods, but that they occur in numbers as small as about 20 per cubic millimetre. I may note that the ordinary methods require about 12 hours for the exhaustive search of a single cubic millimetre of blood, and that our method reduces this time to a little over an hour. Hence, whatever may possibly happen to the parasites between the relapses, the explanation that these are simply produced by increase of numbers is sufficient. Moreover, not a single crescent was ever found in this case, in spite of the numerous exhaustive counts, until after the last relapse. Hence, certainly crescents would appear not to be absolutely essential for the relapses, as we might suppose from the theory of parthenogenesis. No sign of parthenogenesis was observed in the large numbers of crescents examined in other cases.

In several of the cases the small asexual forms were observed to persist in the blood in very small numbers long after the fever had disappeared. In fact, one patient who was kept under observation for 39 days, had practically no fever at all, although both asexual and sexual forms were found by our methods continually in his blood in considerable numbers.

We have attempted to estimate the number of parasites required to produce a given quantity of fever in a case of given duration. Another interesting point is that in a number of cases crescents appear about five days after a parallel appearance of the asexual forms, suggesting that this period is required for the development of the crescents in the inner organs. We also possess curves showing the great irregularity of the production of crescents.

Simultaneously the enumerative methods have furnished an admirable criterion of the exact effect produced by various drugs; but as the researches have been conducted for only four months and are still in progress, it is inadvisable to attempt to summarise our results at present. Curious relations have also been observed between the parasite count and the leucocyte account.

As there was a case of sleeping sickness in my clinic, I thought that the Advisory Committee would be desirous that Dr. Thomson should study it by similar methods. The result has been extremely striking. During 73 days the patient has shown 11 regular periodical rises in the numbers of trypanosomes in his peripheral blood. This study has been rendered possible by the fact that atoxyl has not been always given, in consequence of the effect on the patient's eyes. So far as we can ascertain from the Sleeping Sickness Bureau, the phenomenon of regular periodicity in the case of sleeping sickness has not yet been known, owing probably to the insufficient methods of counting adopted. The same method has thrown light in this case on various methods of treatment, including that of atoxyl, suggesting that sudden falls in the number of trypanosomes cannot always be attributed to the treatment.

(c) G. C. E. Simpson, B.A., M.B., B.Sc., F.R.C.S., was appointed Chemist from early in January, and has been engaged continuously in making parallel studies on many of the cases of malaria regarding the quantitative breakdown of their blood. In the first cases an attempt was made to discover whether any of the immediate derivatives of hæmoglobin were represented in the excretions. This examination met with no success, although it had been reported that hæmoglobin occurs in small quantities in the urine of ordinary malaria cases.

An examination of the excreta for more remote derivatives of hæmoglobin was next undertaken, and has been made in 19 cases, the majority of which were due to malignant parasites. A derivative of great importance is urobilin; and continuous estimations of the urinary excretion show the following fact: in severe cases due to malignant parasites the amount of urobilin representing the distribution of nearly 20 per cent. of the total blood may be excreted. In some cases 12 per cent. or more appear in the urine of 24 hours, showing a large and rapid hæmolysis. In benign cases the distribution is practically negligible. In severe cases the amounts are far greater than in any other disease so far recorded.

Similar investigations have now been commenced on urobilin in fæces of cases of malaria, and still more striking results have been obtained; but it would be inadvisable to speak of these until more material has been carefully studied. These researches are, of course, being pursued in the hope of obtaining light on blackwater fever, as desired by the Advisory Committee.

(d) With regard to researches on Amœbic Dysentery, I am sorry that we could not acquire the services of a trained Protozoologist until the beginning of April, so that nothing definite can be reported under this heading. Dr. H. B. Fantham has been appointed to the work, and has commenced studies on the *Amœba coli* with Dr. Stephens, of this School. At the same time, however, our researches with enumerative methods seemed so important that I have employed him partly for making parallel investigations on the morphology of the trypanosomes in relation to their periodic increase. I may add, also, that Dr. J. G. Thomson, together with Dr. Fantham, has studied some inoculated rats by the same methods in connection with certain Cryotherapy experiments. In fact, I could easily utilise the services of many more workers in these very promising lines of research.

No. 2

LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 1 November, 1910.)

B 10, Exchange Buildings, Liverpool,

SIR,

31st October, 1910.

As requested, I have the honour to enclose, for the information of the Tropical Diseases Advisory Committee, the following reports of the Liverpool School of Tropical Medicine for the six months ending 31st October, showing the manner in which the Government grant to the School has been expended, viz. :—

- (1) Report of the Walter Myers Lecturer of the School (Dr. J. W. W. Stephens).
- (2) Report of the Director of the Runcorn Research Laboratories of the School (Dr. Warrington Yorke).
- (3) Report of the Lecturer in Economic Entomology and Parasitology (Mr. R. Newstead).

(4) I also enclose report by Professor Ronald Ross (Sir Alfred Jones Professor of the School), showing the work which has been done in connection with the special grant of £900 made to the School by the Tropical Diseases Advisory Committee in December last.

I am, &c.,

A. H. MILNE,

Secretary.

Enclosure 1 in No. 2.

SIR,

31st October, 1910.

I BEG to submit the following report on the work done during the period from May 1st to October 31st, 1910 :—

Students.

The number of medical men who attended the June Short Course was 1, and for the Autumn Term 25—total 26. These include members of the Royal Army Medical Corps, Indian Medical Service, West African Medical Staff, Colonial Medical Service, &c.

Diploma of Tropical Medicine.

During the last six months no examination for the Diploma has been held. The next examination takes place on December 12th.

Museum.

The thanks of the School are due to the following gentlemen for their kindness in sending specimens to the School during the last six months:—Dr. K. S. Wise, Georgetown, British Guiana; Dr. Bell, Hong Kong; Captain S. R. Christophers, I.M.S., Kasauli; Dr. Critien, Malta; Dr. Le Fanu, Southern Nigeria; Dr. W. S. Branch, St. Lucia; Dr. Balfour, Wellcome Research Laboratories, Gordon College, Khartoum; Major J. Davidson, I.M.S., Dehra Doon, India; Dr. W. M. Manuk, Lokoja; Dr. Renner, Freetown; Dr. Wood-Mason, Freetown; Dr. McGahey, Gold Coast; Dr. Jeffreys, Shanghai; Colonel Adie, I.M.S., Lahore; Captain R. Markham Carter, I.M.S., Kasauli; Dr. R. H. Kennan, Freetown, Sierra Leone; Mr. R. Newstead, Expedition to Malta; Dr. H. Wolferstan Thomas, Expedition to Manaos, Brazil.

Research Work.

As already reported, I observed in February, 1910, in the blood of a rat infected from a case of sleeping sickness some morphological peculiarities of the trypanosome, which led me to think that it was different from the ordinary *T. gambiense*. I made a prolonged examination of animals infected with the old laboratory strain of *T. gambiense* to ascertain if these peculiarities could be found in them, but always with negative result. Having therefore convinced myself that this trypanosome from a case of sleeping sickness differed from the old laboratory *T. gambiense*, and as a search through the literature showed that such forms had not before been described, I asked Dr. H. B. Fantham to assist me in describing the trypanosome which we believe to be a new species in man and also causing sleeping sickness like *T. gambiense*.

The following is an abstract of a paper contributed by us to the Royal Society and read November 3rd, 1910:—

“*On the peculiar morphology of a Trypanosome from a case of Sleeping Sickness and the possibility of its being a new species (T. rhodesiense),*” by J. W. W. Stephens, M.D., D.P.H., and H. B. Fantham, D.Sc., B.A.

Abstract.

The parasite described in this paper and first observed in February, 1910, was found in the blood of a rat inoculated from a case in Professor Ross's clinic, Royal Southern Hospital, Liverpool.

The patient, W. A., male, aged 26, was infected in North Eastern Rhodesia in September, 1909. He was never in areas infested with *Glossina palpalis*, but travelled for some ten months in areas infested with *Glossina morsitans* and *Glossina fusca*.

The peculiarity of this trypanosome is that among the stout, stumpy forms some have the nucleus at the posterior (non flagellar) end. The nucleus varies in position from central to terminal, and posterior to the blepharoplast (kinetonucleus).

Trypanosomes with posterior nucleus have been seen in life after staining, with methylene blue. They form about 6 per cent. of the stout, stumpy parasites in rats, but vary from day to day. We never found them in animals infected with an old strain of *T. gambiense*. They are not confined to rats (30 “passages”), but occur also in infected *Macacus rhesus*, rabbits and guinea-pigs.

A subsidiary point in the Rhodesian strain is that many of the long trypanosomes in rats have an elongated posterior end. Such forms were frequently seen in the blood of the patient and in guinea-pigs.

Trypanosomes with posterior nucleus have not been described before, either in the blood of sleeping sickness patients or in sub-inoculated animals.

Posterior nuclear forms were seen in animals inoculated from the patient before he was treated with drugs.

In the absence of further knowledge it is difficult to discriminate between whether we are dealing with a “variety” or “local race” of *T. gambiense*, or whether we are dealing with a new species of trypanosome also producing sleeping sickness in man. Yet, on account of its peculiar morphological features, this

Rhodesian trypanosome at least merits a distinct designation as *T. gambiense rhodesiense*, adopting the trinomial nomenclature. Our own view, however, is that we are dealing with a new species of human trypanosome, for which we propose the name *Trypanosoma rhodesiense*.

I have, &c.,
J. W. W. STEPHENS,
Walter Myers Lecturer of the School.

The Secretary,
Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

Enclosure 2 in No. 2.

Runcorn Research Laboratories, Crofton Lodge,

SIR, Runcorn, October 31st, 1910.

As requested, I have the honour to report in brief on the manner in which the Government grant has been expended, and on the work done in the Runcorn Research Laboratories of the Liverpool School of Tropical Medicine from May 1st to October 31st, 1910.

As usual, the money has been partly expended on the current expenses of the laboratory and for the purchase and maintenance of experimental animals necessary for the preservation of the various strains of trypanosomes and other protozoa required for teaching purposes. The remainder of the grant has been spent on apparatus and animals necessary for the research work which has been carried on here during the past six months.

Dr. J. B. Murphy, who had been in charge of the laboratory during my absence for study in Germany, left at the end of May.

I re-commenced work here on June 1st. Dr. R. W. Nauss was appointed Assistant at the end of July.

I have been engaged in investigating the condition of the blood which gives rise to the phenomenon of auto-agglutination of the red blood cells in animals infected with trypanosomes and sleeping sickness in man. My experiments have shown that auto-, iso-, and hetero-agglutinin exist in the blood of many normal animals. These substances are frequently present in much greater amount in the blood of infected animals. Reaction between autoagglutinin and erythrocytes was found to take place only at low temperatures.

It is owing to these facts that clumping of red blood cells is frequently to be observed in fresh coverslip preparations of the blood of infected animals and sleeping sickness patients.

Apart from infection with trypanosomes, well marked autoagglutination is an extremely rare phenomenon. Suspected cases of trypanosomiasis whose blood exhibit considerable clumping of the red corpuscles must therefore be looked upon with great suspicion. The report of this work is awaiting publication.

I have also examined in great detail the animal reactions of a trypanosome obtained from a case of sleeping sickness under the care of Major Ross at the Royal Southern Hospital in Liverpool. The patient had contracted the disease in North-Eastern Rhodesia.

This trypanosome has been shown by Dr. Stephens to exhibit certain morphological differences from the ordinary human trypanosome (*T. gambiense*). I have investigated the action of this parasite on animals of many different species and compared it with that of *T. gambiense*.

These experiments are not yet completed, but they are sufficiently advanced to warrant the statement that the animal reactions of this parasite are very different from those of *T. gambiense*. In other words, the results of my work support the view that the Rhodesian trypanosome is a new species. The details of these experiments will shortly be ready for publication.

I am, &c.,
WARRINGTON YORKE,
Director of the Runcorn Research Laboratories.

The Secretary,
The Incorporated Liverpool School of Tropical Medicine,
Liverpool.

Enclosure 3 in No. 2.

Department of Medical and General Economic Entomology.

SIR,

October 25th, 1910.

I have the honour to submit the following report as bearing upon the work in connection with the Entomological Department of this School for the half-year ending October 26th, 1910.

Students.

The number of students who attended the special and the full course of instructions, respectively, is as follows :—

(A.) Special Entomological Course, as per syllabus* submitted to the Colonial Office (copy enclosed herewith)—					
	Second Term, commencing May 23rd...	...	...	...	6
	Third Term, commencing October 3rd	...	...	...	2
(B.)	Summer Term (short course)	...	...	...	1
(C.)	Autumn Term (full course)	...	...	...	25
	Veterinary Students from the Veterinary Pathology Department	...	...	...	2

In addition to the foregoing, a course of three special lectures was delivered to the undergraduates of the Zoological Department of this University during the summer term.

Special Expedition.

On the 25th June I proceeded to Malta on a special expedition to investigate the problems connected with the menace to health caused by sand flies of the genus *Phlebotomus*, the main object being to discover the chief breeding-places of these insects, in the hope that some practical measures might be devised for destroying them in the larval stages. I remained in the Island for a period of 58 days, returning to Liverpool on September 11th following the date of my departure. The following statement may be taken as a brief resumé of the results obtained :—

1. Larvæ were found between the crevices of rock in a small cave at Citta Vecchia. They were feeding upon the rejectamenta of wood lice (*Oniscus* sp.) and faecal matter of the larvæ of various insects, &c.
2. A careful and unremitting search was made for the larvæ in latrines, drains, main sewers, cesspools, refuse of various kinds, fruit, dead stems of the cactus (*Opuntia* sp.) common to the country, and various other substances, &c., all with negative results.
3. It was discovered for the first time that three distinct species of *Phlebotomus* occur in the Island: two of them are equally abundant; the third may at present be considered uncommon. Previous investigations have claimed that only one species, viz., *Phlebotomus papatasi*, occur in the Maltese Islands; but it is clearly evident that the additional species had been overlooked.
4. The discovery of some important structural details concerning the anatomy of these insects was made, and a long series of drawings illustrative of the salient characteristics were prepared, as well as a series illustrative of the internal anatomy.

A full report of this investigation is in the course of preparation, and will be issued towards the end of the year; meanwhile, I have pleasure in stating that the Government of the Island afforded every facility for carrying out the work of the investigation, so that much more was accomplished during the relatively short period of my stay on the Island than could otherwise have been done.

In addition to the special work of the expedition collections of other blood-sucking insects and ticks were made, as well as a series of intestinal worms and other things bearing either directly or indirectly upon the subject of disease in man and his domesticated animals.

I have to report also that His Excellency the Governor elected me as a member of the Special Commission appointed by the Government to suggest means for stamping out the "fluted scale insect" (*Icerya purchasi*), recently introduced into the Island on orange trees, &c. At the meeting held on Thursday, 14th July, I made

* Not reprinted.

the following recommendations, which are copied from the minutes of the aforesaid meeting :—

- “ A. Hard pruning and thorough spraying with either lime and sulphur or paraffin emulsion;
- “ B. Fumigation with hydrocyanic acid gas; or
- “ C. The complete destruction of all infested plants and trees.

“ In view of the fact that the disease was so far localized to a small area, he very strongly advocated the destruction of all the infested trees, this being, in his opinion, the only way for at once stamping out the pest. A. and B. methods were only half measures, and might not be successful. As an effect of washing, the tree would not bear for two or three years after, and it would require more than one application before the tree could be thoroughly cleansed.

“ He said that the fluted scale insect in other countries with a climate similar to that of Malta had thriven, and he feared very much that it would be the same in our case.

“ In view of Mr. Newstead's strong recommendations, it was decided to recommend to Government the adoption of the third measure referred to by Mr. Newstead—that of destruction of all infested trees.”

Papers published.

1. A Report on the Mosquitos of the Amazon Region. Joint with Dr. Wolferstan Thomas. *Annals of Tropical Medicine and Parasitology*, Vol. IV., No. 1, June, 1910.

2. A Mealy Bug injurious to the Lebbek Trees of Cairo. Appendix to Mr. F. C. Willcock's (Entomologist to the Khedevial Agricultural Society) paper. *Bulletin of the Entomological Research*, Vol. I., July, 1910.

3. Some Insect Pests affecting Cultivated Plants in the West Indies. *Journal Royal Horticultural Society*, Vol. XXXVI., Part 1.

Papers completed and awaiting publication.

In addition to those papers enumerated in the report submitted in May last, a further contribution dealing with the Coccidæ, &c., of the Uganda Protectorate will be issued in the forthcoming number of the *Bulletin of the African Entomological Research*.

Identification of Blood-sucking Flies and other Insects of Economic Importance.

West Africa. Various Colonies and Protectorates.—Three separate collections of mosquitos, comprising in all 512 specimens representing 27 species; also three species of *Tabanus* from Sierra Leone.

Great Britain.—Several species of agricultural and horticultural pests; advice regarding the best means of prevention and control was given to the various correspondents.

I have, &c.,
ROBT. NEWSTEAD.

The Secretary,
Incorporated Liverpool School of Tropical Medicine,
B 10, Exchange Buildings, Liverpool.

Enclosure 4 in No. 2.

REPORT BY PROFESSOR R. ROSS, F.R.S., C.B.

SIR,

27th October, 1910.

ON the 24th November, 1909, the Advisory Committee allotted funds for a descriptive bibliography of malaria, for research work on cases of malaria in Liverpool, for a chemist for research work, and for researches on Amœbic dysentery. All these studies were placed under me, and I have already reported upon the work done up till May of this year. I now bring the report up to date.

(a.) Mr. W. Drawz has continued the bibliography of malaria. More than 3,000 references have been collected from all the languages mentioned in my previous report, and most of these have been classified and card indexed, while drafts, resumés, and notes of many of the most important papers have been collected. The list is by no means yet complete, especially as regards the Spanish, Portuguese, and French papers; and owing to extreme pressure of work I have not yet been able to undertake the analysis of any but a few of them—a thing which must be done by myself. The collection and examination of the literature bearing on the various species of malaria-bearing mosquitos occupied us for two months. In addition to

the general literature, I have now set Mr. Drawz upon the collection and classification of official reports on local malaria in British and other possessions, with a view to drawing up a memorandum on the subject which I promised a year ago to the Advisory Committee. The magnitude of this work becomes more and more apparent as we proceed in it. We have spent the last month on the study of malaria in India, with which I propose to commence my series of memoranda to the Committee.

I have become convinced that such bibliographic work is now absolutely indispensable to advance, not only in malaria, but in tropical medicine in general. The papers on every branch of it, written as they are in many languages, cannot be dealt with except by organised effort. If papers are overlooked there is always a danger of money and effort being spent in repeating work already done, while teaching cannot be brought up to date. Moreover, many of the languages are not understood by the workers; while they have no time to collect references and to apply at various libraries for special works. Mr. Drawz's services have been invaluable, not only for the malaria bibliography, but, when his time can be spared, to other branches of study at this school. He has been of great assistance, for instance, to our Entomological Department, and to Sir Rubert Boyce in connection with yellow fever. It will therefore be a calamity if we are obliged to lose his services just as he has become trained in the work.

(b.) The researches carried out under me up to the end of July have been reported upon in eight separate papers, of which seven have been accepted by the Royal Society, while several other papers will be ready before the end of the year. Dr. D. Thomson, as already reported, has been employed continuously at the Royal Southern Hospital in the study of tropical diseases there, especially malarial fever, by exact enumerative methods. To the end of July we studied 33 cases of malaria by minute daily counts. Our paper, which will be published by the Royal Society, discloses many new points of interest in connection with the subject regarding which little has recently been done owing to the exhaustion of the older methods of research. The principal points disclosed by the more exact studies are as follows:—(1) No fever is produced unless the parasites exceed a given limit in number, say, from 500-1,500 per c.m. (2) The parasites tend to remain continuously in the blood in small numbers between the febrile relapses, thus giving a coherent theory of the malarial invasion and of its continuance for many months, even without fever. (3) There is a close correlation between the number of parasites and the amount of fever caused by them. The parasites on 127 days of fever were compared with those on 151 days without fever, and were found to be from 30 to 36 times more numerous. We hope shortly to obtain exact figures of the fever-producing capacity of a given number of parasites and estimates of the resistance of various patients. (4) Studies on quinine have given a numerical estimate of its effect, a few days' use of the drug having reduced the parasites by from 50 to 80 per cent. (5) Numerous interesting results have been obtained regarding the sexual forms. Thus, the crescents apparently require eight to ten days for development, and the persistence of them in the peripheral blood appears to be due, not to their long life, as frequently thought, but more probably to the stock of them being kept up by the constant hatching out of fresh broods. Quinine effects their numbers only by destroying the generating cells—an important point in connection with prevention. (6) Many other enumerative studies were made on the leucocytes, the hæmoglobin, and treatment by various agents. Thus, methylene blue and soamine appear to have no effect on the parasites.

One of the main objects of this research was to prepare for an exact study of blackwater fever. It was fortunate for this purpose that a case occurred in the hospital while under enumerative study; and this disclosed an important new point. The patient had three separate attacks of fever. The first was an ordinary malarial attack, caused by the parasites. The second was a typical blackwater attack, during which no parasites could be detected, even by our improved methods. The third attack consisted of a typical blackwater *fever*, but without any blackwater, and also without the presence of parasites being detected, even after large numbers of blood films were examined by these methods. This result shows that there must be some other element in blackwater fever, besides the malaria parasites, which produce that special symptom.

(c.) Dr. Simpson has been employed on the chemical study of all these cases, and has furnished a long paper, of which an abstract will be published by the Royal Society. His results are already important. He has shown that the hæmoglobin which is so largely liberated from the red corpuscles by malaria escapes mostly in the

fæces, and not in the urine, as generally supposed. This is proved by his quantitative studies of the urobilin passed in the fæces. His work has, as was intended, special reference to blackwater fever. It was proved that in our case nearly all the patient's hæmoglobin was liberated during his blackwater attack, and that nearly all of it escaped by the ailmentary canal. The amount compared in the urine was only a small overflow, and we think that this throws quite a new light upon the blackwater process.

(d.) The case of sleeping sickness mentioned in my first report has led to other interesting work. Dr. D. Thomson has shown that the trypanosomes increased in numbers every week, suggesting that there is a parasitic cycle with these parasites, as with malaria. This cycle was continued without interruption, and in spite of treatment by atoxyl and other agents, until the patient's death on the 29th June, a period of 134 days. Dr. Thomson also showed that the fever and the leucocytes have an exactly corresponding variation; that atoxyl, arsenic, and methylene blue had little effect, and that the inoculation of dead trypanosomes and leucocytes strongly influenced the curves—a subject which must be closely studied in the future.

(e.) Dr. Fantham, who was employed on work on amœbic dysentery, has commenced this work, but, owing to the absence of good cases, has not been able to progress far in it. He commenced his researches only at the beginning of April last, but his services have been extremely valuable in other directions. As soon as the cycle of the trypanosomes was detected, I asked him to investigate the corresponding cytological changes, if any. He has detected that there are such corresponding changes, and has been able to confirm by enumerative methods that they are the same as those described by Moore and Breinl. He has also shown experimentally that the round forms are capable of infecting directly. At the same time he has been employed, together with Dr. John Thomson, who has been working on the effect of cold on disease by funds given by Sir Edwin Durning-Lawrence, on examining the trypanosome cycle in animals. These workers have confirmed the existence of the cycle in rats and guinea-pigs, and have demonstrated many minor points of interest, such as the effect of treatment and the different resistance of such animals.

(f.) One of the most important developments arising out of our case of sleeping sickness has been that Dr. Stephens has detected a cytological difference between the trypanosome and the one hitherto described in man. This difference is so marked that he and Dr. Fantham consider that we have to deal with a new species, which they have named *Trypanosoma rhodesiense*. The work of Drs. Fantham and John Thomson tends to show that the strain is much more virulent than the ordinary one in animals. Further work is now in progress.

I am convinced that such work, consisting as it does of the combined efforts of many researchers, is most promising. The workers who have been employed in consequence of the funds allotted by the Advisory Committee have been assisted by another chemist (Mr. Edie), by Dr. John Thomson, by Professor B. Moore, and by all the other workers of the school. The result is that we can bring much skilled attention to bear on each case and are thus obtaining many new observations of importance, especially as new methods are being employed. Moreover the work helps to supply us with a number of young and well-trained men, whose services will be invaluable hereafter. There is an unlimited field for research on tropical diseases in our laboratories; and as such researches are much less costly than expeditions to the tropics, I think that it would be very wise to continue them, more especially as the workers have now become thoroughly trained. We are therefore proceeding at once to still more detailed researches, in which we propose to undertake hourly countings of the parasites, together with hourly studies of the pathological reactions and of drugs. At the same time, the methods employed are being continuously improved. I should add that the work reported upon covers only about seven months of the year, and that the researches now being done cannot be summed up in time for this communication.

The Liverpool School of Tropical Medicine has further assisted the work mentioned above by appointing a special assistant to Mr. Newstead for minute studies of the Culicidæ, and by giving the services of an additional typist for the bibliographic work, and Dr. Korke, Colonial Fellow, has assisted the work.

RONALD ROSS.

The Secretary,

The Incorporated Liverpool School of Tropical Medicine,
Liverpool.

APPENDIX VI.

Reports on Work done in Colonial Laboratories.

No. 1.

BRITISH GUIANA.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 8 August, 1910.)

MY LORD, Government House, Georgetown, Demerara, 16th July, 1910.

IN continuation of my despatch of the 30th October last,* I have the honour to transmit a report by Dr. K. S. Wise, Government Bacteriologist in British Guiana, on tropical diseases research work done in the laboratory during the half year ended the 31st March, 1910.

I have, &c.,

F. M. HODGSON.

Enclosure in No. 1.

REPORT of the Government Bacteriologist, British Guiana, to the Tropical Diseases Research Fund, from October, 1909, to March, 1910.

The presence of adult Filaria Bancroftii in internal organs.

The adult *Filaria Bancroftii* is well known as an inhabitant of the lymphatics of the mesentery, and of the extremities; it has, however, been found during post-mortem examinations in this Colony in the lymphatics of the kidney, liver, and epididymis.

In the kidney the parasite is found occasionally alive, but generally cretified, situated in the lymphatics of the connective tissue beneath the epithelium lining the pelvis of the kidney. It occurs sometimes in both, sometimes in only one kidney. When alive they are twisted and coiled in amongst each other till it is difficult to separate them; both sexes are present, and the worms are usually six to twelve in number.

When cretified they appear as yellowish granules about $\frac{1}{4}$ inch longest diameter. Usually it is easy to observe that the calcareous sheath was formed round some coiled structure as it will show rounded ends, and a constricted middle rather like a figure of eight; sometimes it is obviously a calcareous twisted line.

The calcareous material is laid down as plates in the cutaneous part of the worm. These irregular plates—sometimes, however, regularly hexagonal—are added till the parts weld into a complete covering; through this armature it is impossible to see anything. The material readily gives off gas with hydrochloric acid, and so is presumably composed of carbonates of the alkaline earths.

While the cutaneous part of the worm is impregnated with calcareous salts, the internal organs shrink and form merely a central thread. This dark core once formed does not show any structure. In some instances partial cretification has taken place, one part being membranous, allowing the end, and sometimes the sex, to be ascertained, the other cretaceous preventing any structure to be seen.

In the last 1,000 post-mortem examinations the presence of *Filaria* has been proved in 24 cases in the kidney.

Table of cases in which the Filaria Bancroftii worms were found in the kidney.

No.	Sex.	Age.	Country.	Race.	Cause of Death.	Coincident Filarial Disease.	Filaria in Kidney.
1	F.	14	British Guiana ...	Black ...	Septicaemia ...	... ..	Partly calcareous.
2	F.	17	British Guiana ...	Mixed ...	Miliary tuberculosis	Both legs elephantoid.	Calcareous.
3	F.	70	Barbados ...	Black ...	Cirrhosis of liver	... ..	Calcareous.
4	F.	17	British Guiana ...	Black ...	Double pleurisy ...	... ..	Calcareous.
5	M.	38	British Guiana ...	Black ...	Pyonephrosis ...	... ..	Calcareous.

* See page 90 of [Cd. 4999].

No.	Sex.	Age.	Country.	Race.	Cause of Death.	Coincident Filarial Disease.	Filaria in Kidney.
6	F.	68	British Guiana ...	Black ...	Malignant endocarditis	... ..	Calcareous.
7	F.	75	India ...	East Indian ...	Granular kidney ...	... ..	Calcareous.
8	M.	20	British Guiana ...	Black ...	Lobar pneumonia...	... ..	Calcareous.
9	M.	60	British Guiana ...	Mixed ...	Lobar pneumonia...	Right leg elephantoid.	Calcareous.
10	F.	19	British Guiana ...	Black ...	Abscess of lung ...	... ..	Alive.
11	F.	48	British Guiana ...	Black ...	Peritonitis ...	... ..	Alive.
12	F.	32	British Guiana ...	Mixed ...	Chronic bronchitis	Both legs elephantoid.	Calcareous.
13	F.	80	Madeira ...	Portuguese ...	Morbus cordis ...	Both legs elephantoid.	Calcareous.
14	F.	15	British Guiana ...	Aboriginal ...	Lobar pneumonia...	... ..	Alive.
15	F.	36	British Guiana ...	Portuguese ...	Lobar pneumonia...	... ..	Calcareous.
16	F.	40	British Guiana ...	Black ...	Granular kidney ...	... ..	Alive.
17	M.	48	India ...	East Indian ...	Lobar pneumonia...	... ..	Calcareous.
18	F.	39	British Guiana ...	Black ...	Ulcerative colitis ...	... ..	Calcareous.
19	F.	19	British Guiana ...	East Indian ...	Ankylostomiasis ...	... ..	Partly calcareous.
20	F.	23	British Guiana ...	Black ...	Malaria ...	... ..	Calcareous.
21	F.	29	British Guiana ...	Black ...	Tuberculosis lungs	... ..	Calcareous.
22	M.	48	Barbados ...	Black ...	Morbus cordis ...	... ..	Calcareous.
23	F.	42	British Guiana ...	Black ...	Tuberculosis lungs	... ..	Calcareous.
24	M.	52	British Guiana ...	Black ...	Ulcerative colitis ...	... ..	Calcareous.

In the liver the *Filaria Bancroftii* has been found twice in the last 1,000 post-mortem examinations. In both instances the worm was in a cretified state, and lay in the lymphatics of the capsule of the organ under the right dome of the diaphragm; it is difficult to state if there were one or more worms present in the masses.

Table of cases in which Filaria Bancroftii worms were found in the liver.

No.	Sex.	Age.	Country.	Race.	Cause of Death.	Coincident Filarial Disease.	Filaria in Liver.
1	M.	48	India ...	East Indian ...	Ankylostomiasis ...	... ..	Calcareous.
2	F.	38	British Guiana ...	Black ...	Lobar pneumonia...	... ..	Calcareous.

In the epididymis the *Filaria Bancroftii* seems to have a strong predilection for the connective tissue binding the lower part of the epididymis to the testis proper. In the majority of cases the worm is found lying in this exact spot.

It is usually found alive or dead (membranous) in a small cavity of pus. Only three times has it been found calcareous in contrast to the frequency of this occurrence in the kidney and liver.

The *Filaria Bancroftii* has been found 14 times in the epididymis in the last 1,000 post-mortem examinations.

Table of cases in which the Filaria Bancroftii worms were found in the epididymis.

No.	Age.	Country.	Race.	Cause of Death.	Coincident Filarial Disease.	Filaria in Epididymis.
1.	34	India ...	East Indian ...	Septicaemia ...	... ..	Alive.
2.	40	India ...	East Indian ...	Septicaemia ...	... ..	Dead. Membranous.
3.	52	India ...	East Indian ...	Chronic bronchitis	... ..	Alive.
4.	40	British Guiana ...	Black ...	Septicaemia ...	Slight elephantiasis scroti.	Alive.
5.	38	India ...	East Indian ...	Septicaemia ...	... ..	Dead. Membranous.
6.	56	Barbados ...	Black ...	Malaria ...	... ..	Calcareous.
7.	55	India ...	East Indian ...	Lobar pneumonia	... ..	Alive.
8.	56	Barbados ...	Black ...	Malaria ...	... ..	Calcareous.
9.	52	British Guiana ...	Black ...	Chronic Bright's disease.	... ..	Dead. Membranous.
10.	35	British Guiana ...	Mixed ...	Morbus cordis ...	... ..	Alive.
11.	39	British Guiana ...	Black ...	Lobar pneumonia -	... ..	Alive.
12.	25	India ...	East Indian ...	Septicaemia ...	... ..	Dead. Membranous.
13.	42	British Guiana ...	Black ...	Tuberculosis lungs	... ..	Calcareous.
14.	32	British Guiana ...	Portuguese ...	Tuberculosis miliary.	... ..	Alive.

The Nastin treatment of leprosy.

In December, 1908, Professor Deycke began the Nastin treatment of the lepers at the Government Leper Asylum, Mahaica. He continued this treatment till

Table V.

Approximate length of time the disease has existed.

	Men.	Women.
1 year and under	3	1
2-3 years	5	2
4-5 years	18	7
6-8 years	17	11
9-12 years	6	4
Over 12 years	1	1
	50	26

In observing the destruction of the leprosy bacilli the appearances seen were divided up roughly into several classes as follows:—Slight or no destruction of bacilli, medium destruction of bacilli, and advanced destruction of bacilli.

After three months' injection the results showed that:—

- 50 per cent. had slight or no destruction of bacilli.
- 36 per cent. had medium destruction of bacilli.
- 14 per cent. had advanced destruction of bacilli.

After three months' injection, two months' rest, and a further three months' injection the results were as follows:—

- 26·3 per cent. showed slight or no destruction.
- 13·1 per cent. showed medium destruction.
- 49·2 per cent. showed advanced destruction.
- 2·6 per cent. showed very few bacilli at all.
- 5·2 per cent. showed no bacilli.
- 1·3 per cent., the treatment was not continued.
- 2·6 per cent. died.

After three months' injection, two months' rest, three months' injection, two months' rest, and a further three months' injection, the results were as follows:—

- 18·6 per cent. showed slight or no destruction.
- 17·8 per cent. showed medium destruction.
- 26·4 per cent. showed advanced destruction.
- 6·9 per cent. showed very few bacilli at all.
- 8·9 per cent. showed no bacilli.
- 13·4 per cent., the treatment was not continued.
- 8·8 per cent. died.

The first type of change was that in some cases a gradual softening of the leprotic nodule occurred, leaving sometimes nothing at all, sometimes a scar.

The second type of change noticed was the production of ulceration in places where previously was a nodule or a leprotic infiltration. This ulceration will continue for two to three weeks, and finally heal to form a white scar.

The third type of change noticed was apparently a specific reaction; high fever begins with general malaise, and after a few days pain is felt in all or some of the leprosy lesions, and a rapid breaking down of the leprotic formation ensues, with or without ulceration. This appears to indicate that the administration of nastin has been pushed too far.

The fourth effect of the nastin treatment has reference to the anæsthetic areas. These areas recover sensation more or less according to the length of time during which they have existed.

The fifth effect is a pigmentary change occurring more particularly in leprotic plaques in the lighter skinned races. These areas often become much darker in colour, eventually returning to the original colour.

The sixth effect of the nastin treatment showed itself as some influence on the kidney, since intermittent albuminuria was much more frequent than amongst the untreated lepers.

Chyluria.—This is a case which has been followed from the very first symptoms of the disease to the end of the first attack.

The patient was a female of the black race born in British Guiana and aged 35

She states that the appearance of the urine has always in the past been natural, no discolouration having ever taken place. No history of any filarial disease could be elicited. There were no enlarged glands of the groin or thickened areas of the skin. On the 22nd September, 1909, the urine for the first time showed any change.

22nd September, 1909.—Urine appears to contain blood. Specific gravity 1025. Reaction alkaline. Great quantity of albumin present, and hæmoglobin readily detected in the filtered fluid. The deposit shows numerous red and white blood corpuscles. No pus or filarial embryos were found, and no fat could be detected.

25th September, 1909.—The chemical character of the urine much the same. Three live embryos of *Filaria Bancroftii* found. No fat could be extracted.

27th September, 1909.—A blood clot was passed with the urine. Apparently formed in the bladder.

28th September, 1909.—Still blood in the urine but less in quantity. No pus present. Two filarial embryos found.

29th September, 1909.—Still blood present. No fat found in 50 grammes of urine.

4th October, 1909.—Urine has changed its bloody appearance. There is no naked-eye signs of blood, not even a smoky colour. The specific gravity is 1010. It is clear and light brown in the upper part, and shows a whitish deposit. The deposit examined microscopically is composed of a few triple phosphate crystals, much granular, amorphous hæmoglobin as though derived from a breaking-up clot. A few pus cells and leucocytes are present. Many filarial embryos are present. From 50 grammes of urine 0·0156 gramme of fat was extracted, *i.e.*, 0·03 per cent. With Osmic acid this extracted material turned black.

5th October, 1909.—The urine showed a slight milky cloudiness. The fat was estimated at 0·21 per cent. Slight cloud albumin.

6th October, 1909.—The urine was chyluric in appearance, and formed a complete clot typically from top to bottom. Seven filarial embryos to a cover glass were found in the deposit. Fat was present at 0·552 per cent.

10th October, 1909.—Fat 0·002 per cent.

11th October, 1909.—Fat, 0·045 per cent. Much clotting was present, few leucocytes. No filarial embryos. Deep cloud albumin.

13th October, 1909.—Fat was in too small quantity to estimate, but was present in traces.

14th October, 1909.—Day urine: fat, 0·033 per cent.

Night urine: fat, 0·28 per cent.

15th October, 1909.—Fat, 0·002 per cent.

16th October, 1909.—Fat was present merely in traces.

17th October, 1909.—No fat discovered. No filarial embryos found.

21st October, 1909.—No fat discovered. Urine appears normal. Slight cloud albumin. No filarial embryos present.

30th October, 1909.—Urine appears quite normal except for a slight cloud of albumin. No fat or filarial embryos were present.

The symptoms were exceedingly slight, and of no distressing character. The temperature never exceeded 101° F., and only reached that low level twice or thrice on 6th and 14th October. With the exception of slight indefinite pains in the loins, and occasional acute pain during the passage of blood clots, other symptoms were absent.

No. 2

CEYLON.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 28 February, 1910.)

The Queen's Cottage, Nuwara Eliya, Ceylon,

MY LORD,

8th February, 1910.

WITH reference to Sir Hugh Clifford's despatch of the 3rd August last,* I have the honour to forward herewith, for transmission to the Advisory Committee of the Tropical Diseases Research Fund, a report by Dr. Aldo

* See page 98 of [Cd. 4999].

Castellani, M.D., on the research work carried out in the Clinic for Tropical Diseases and Bacteriological Institute during the half-year ended the 31st December, 1909.

I have, &c.,
HENRY McCALLUM,
Governor, &c.

Enclosure in No. 2.

REPORT on Investigation Work carried out in the Clinic for Tropical Diseases and Bacteriological Institute from July 1st to December 31st, 1909, by ALDO CASTELLANI, M.D.

During the last six months the routine work of the Bacteriological Institute has continued to occupy practically the whole of my official time. I have been able, however, to do some research work—mostly outside office hours—on the following subjects:—

1. Dhobie Itch and its fungi.
2. Tropical Bronchomycosis.
3. Anchylostomyasis Fever. (This investigation is not yet complete.)
4. A new species of intestinal Spirillum.

I would like to express here my thanks to Mr. E. Burgess, the Assistant Bacteriologist, for much assistance given during these researches.

Dhobie Itch.—New species of fungus causing it.

In 1905 I separated Dhobie Itch from the ordinary forms of *T. Corporis*, and Macleod suggested for the affection the term of *Tinea Cruris*. I stated at the time that the eruption was caused by different species of fungi, the commonest of which I called a few months later *Trichophyton Cruris*. Pernet found and described a fungus in a case of Dhobie Itch, which I later named *Tr. Perneti*. In 1907 Sabouraud made an investigation into an epidemic of Dhobie Itch occurring in a French town, and came to the conclusion that *Tinea Cruris*, or, as he prefers to call it, *Tinea Inguinalis*, should be separated from *T. Corporis*. For the trychoplytoy-like organisms observed in the disease he created a new genus: Epidermophyton. The principal characters of this genus are that the fungi do not attack the hair follicles, do not produce suppuration, and their cultures show very quickly forms of degeneration. Sabouraud isolated only one species in all his cases; but in the tropics, in my experience, there cannot be any doubt on the plurality of species of the fungi producing Dhobie Itch. The fungi described so far were:—

1. *Epid. Cruris* (Castellani, 1905), syn. *Epid. inguinale* (Sabouraud, 1907).
Colonies in maltose agar whitish, occasionally orbicular; later on showing a greenish colour.
2. *Epid. Perneti* (Castellani, 1907), syn. *Trych. Perneti*.
Colonies in maltose agar of a delicate pinkish colour. The pinkish colour is lost in subcultures.

To these two species I am now in a position to add a third one, which I have isolated from two cases of the so-called eczematoïd type of *T. Cruris*. In one patient the eruption was localized to the groins, scrotum, and thighs; in the other, besides the scrotum and thighs being affected, the armpits and portions of the chest and abdomen were affected. I may here remark that it is an error to consider *T. Cruris* as always localized to the groins or the armpits. The affection generally begins in those regions, but in many cases it may spread to any other part of the body except the scalp; indeed I have seen a few cases in which the disease started on the chest or arms or face and then spread to the groin and armpits.

Description of the fungus.—In preparations of liq. potass. from the affected parts mycelial tubes and free spores are observed, identical to what one sees in *Epid. Cruris* and *Epid. Perneti*, and similar to any trychophyton of the megalo-sporon type. The spores are large, globular 4 to 6 microns, with a double contour. The mycelial tubes, 2 to 3½ ins., are straight, or bent, or variously shaped.

Cultures.—*Sabouraud agar*:—The growth begins to appear four to six days after inoculation as a raised red spot, which gradually enlarges. The full-grown colonies are of a deep red colour, either with a central knob or crateriform, and

are partly covered by a white *duvet*. In old cultures the white *duvet* is more abundant and thicker and covers the whole growth, and may hide the red pigmentation almost completely. The pigmentation has not been lost in subcultures so far (19th sub-culture).

Glucose agar.—The cultures are of a very deep blood-red colour, and portions of the medium may appear of the same colour. In old cultures a large amount of white *duvet* is present all over the surface of the growth. The red pigmentation at the time of writing is still characteristic (19th transplanted subculture).

Mannite.—Colonies deep red covered with white *duvet*, with central knob. After a time the whole surface of the growth shows abundant whitish fluff.

Maltose.—In maltose agar (2 per cent.), alkaline or acid, the colonies are whitish; in maltose agar 4 per cent., the colonies may occasionally be red.

Ordinary agar.—The fungus grows well with colonies having a white knob; later on the colonies show a peripheral greenish ring encircled by a thin whitish or whitish-greenish zone.

Saccharine agar.—One sees a central white knob with a yellowish ring and then a whitish zone at the periphery.

Glycerine agar.—White growth with central white knob and white, powdery surface.

The principal cultural characters already described and those present in other media are collected in the following table:—

The Principal Cultural Characters of Epidermophyton Rubrum.

Sabouraud Agar.—Red growth, with later white *duvet*.

Glucose Agar, 2 per cent.—Deep red growth, with later white, fluffy surface.

Mannite Agar, 2 per cent.—Deep red growth, with later white, fluffy surface.

Saccharose Agar, 2 per cent.—Cream-coloured growth, with white, powdery surface.

Maltose Acid Agar, 2 per cent.—Cream-coloured growth, with white, powdery surface.

Maltose Alkaline Agar, 2 per cent.—Cream-coloured growth, with white, powdery surface.

Lactose Agar, 2 per cent.—Cream-coloured growth, with white, powdery surface.

Glycerine Agar, 2 per cent.—Cream-coloured growth, with white, powdery surface.

Saccharine Agar, 2 per cent.—White-coloured growth, with white, powdery surface.

(After one month the growth on saccharine presented a white central knob surrounded by a greyish-white zone. This greyish-white zone was surrounded by a distinct yellow ring, and outside this was another zone of grey-white colour.)

Agar (plain).—As saccharine.

Gelatine.—White growth. Non-liquefied; 21 days.

Serum.—Non-liquefied; 21 days.

Litmus Milk.—Alkaline. Complete separation in 7 days.

Broth.—Growth on surface and at bottom of tube of pale yellow colour.

Peptone Water.—Growth at bottom of tube. White.

Lactose Litmus Broth, 2 per cent.—No acidity. Good surface growth of greenish-white colour.

Mannite Litmus Broth, 2 per cent.—No acidity. Good surface growth. White.

Dulcitate Litmus Broth, 2 per cent.—No acidity. Good growth at bottom of tube.

Glucose Litmus Broth, 2 per cent.—No acidity. Good surface growth. Red with whitish *duvet*.

Maltose Litmus Broth, 2 per cent.—No acidity. Superficial whitish growth.

Saccharose Litmus Broth, 2 per cent.—No acidity. Superficial greenish-white growth.

Lævulose Litmus Broth, 1 per cent.—No acidity. Abundant greenish-white surface growth.

Inulin Litmus Broth, 1 per cent.—No acidity. Abundant greenish-yellow surface growth.

Raffinose Litmus Broth, 1 per cent.—No acidity. Abundant greenish-white surface growth.

Galactose Litmus Broth, 1 per cent.—No acidity. Abundant greenish-yellow surface growth.

Dextrin Litmus Broth, 1 per cent.—No acidity. Only slight growth at bottom of tube, none on surface.

Arabinose Litmus Broth, 1 per cent.—No acidity. Greenish-white surface growth.

Adonite Litmus Broth, 1 per cent.—No acidity. Growth only at bottom of tube and very slight.

Nutrose Litmus Broth, 1 per cent.—No acidity. Growth at bottom of tube and also abundant surface growth of greenish-yellow colour.

Observations on subcultures.—Subcultures made from a Sabouraud or glucose culture on Sabouraud or glucose media will be deep red as the original cultures, but subcultures on agar, saccharine agar, and saccharose agar will be white or greenish or yellowish. Subcultures from an agar culture (white) on ordinary agar, saccharine, and saccharose will be white, but if Sabouraud agar tubes or glucose or mannite tubes be inoculated from a white agar colony the fungus will grow not white but deep red. The colour of the fungus is therefore due to the composition of the medium on which it is inoculated. In Sabouraud, glucose and mannite media the fungus so far grows red. I have at the present time the 19th generation, and the fungus has the same characteristics as in the first.

Hanging drop cultures.—Hanging-drop cultures in Sabouraud maltose or ordinary broth present the characters of the other Epidermophyton. Reproduction takes place by sprouting and branching of the mycelial tubes; clamydospores are present. It is interesting to note the rarity of lateral conidia.

Conclusions.—1. *T. Cruris*, or Dhobie Itch, is caused by several species of Epidermophyton.

2. To the two Epid. already known—*Epidermophyton Cruris* (Cast.) and *Epid. Perneti* (Cast.)—the one I have above described may be added. For this species I propose the name of *Epid. Rubrum*.

3. *Epidermophyton Rubrum* is characterised principally by the deep red pigmentation of its growth in Sabouraud media, glucose, and mannite agars; while its growth is white in ordinary agar; pigmentation is very persistent, as it is still very characteristic in the 19th subcultures.

NEW INTESTINAL SPIRILLUM.

I have recently come across two cases of a peculiar type of acute fatal enterocolitis, showing intermediate symptoms between dysentery and cholera. Some of the stools were serous, cholera-like; others consisted practically of mucus only. There was no blood. Both cases died within 48 hours. In one case the disease was said to have begun after eating dry fish. The stools collected in sterile Petri dishes were examined for vibrio cholera, with negative results. Instead 85 per cent. of the colonies which developed on bile-salt agar and ordinary agar plates were of a peculiar spirillum; the other colonies being of coli-like germs.

Description of the Spirillum.

Morphology.—The spirillum varies greatly in length and shape; the same preparation from an agar or broth culture will show some very long (20 to 40 microns) individuals; medium size with 2-4 coils, and short bacillary comma-like forms. The difference in shape is such that at first I thought it might be a case of symbiosis between a bacillus and a spirillus, but plating and replating did never succeed in separating the two forms which, therefore, I believe to be one and the same organism. The germ is easily stained with the usual aniline dyes. It is Gram-negative.

Culture characters.—These are collected in the following table:—

Cultural Characters of the Spirillum.

Litmus Milk.—No acidity. (After 8 weeks the milk was distinctly alkaline and peptonised.)

Broth.—General turbidity. Pellicle.

Peptone Water.—General turbidity. Slight pellicle.

Gelatine.—Not liquefied.

Serum.—Not liquefied.

Agar.—Whitish. Coli-like.

Lactose Litmus Broth, 2 per cent.—No change. Fair growth.

Saccharose Litmus Broth, 2 per cent.—No change. Fair growth.

Dulcete Litmus Broth, 2 per cent.—No change. Fair growth.

Mannite Litmus Broth, 2 per cent.—No change. Fair growth.
 Glucose Litmus Broth, 2 per cent.—No change. Fair growth.
 Maltose Litmus Broth, 2 per cent.—No change. Fair growth.
 Dextrin Litmus Broth, 1 per cent.—No change. Fair growth.
 Raffinose Litmus Broth, 1 per cent.—No change. Fair growth.
 Arabinose Litmus Broth, 1 per cent.—No change. Fair growth.
 Adonite Litmus Broth, 1 per cent.—No change. Fair growth.
 Inulin Litmus Broth, 1 per cent.—No change. Fair growth.
 Nutrose Litmus Broth, 1 per cent.—No change. Fair growth.
 Galactose Litmus Broth, 1 per cent.—No change. Fair growth.
 Laevulose Litmus Broth, 1 per cent.—No change. Fair growth.
 Indole.—Negative.

Gram.—Negative. Very motile.

Pathogenicity.—For the first two weeks after isolation the spirillum was pathogenic to guinea-pigs and rabbits, the animals dying 24-48 hours after an injection of 2 c.c. broth culture hypodermic or 1 c.c. intraperitoneally. Later on it lost its pathogenicity.

Conclusion. The culture characters show that the spirillum is most probably a new species, for which I propose the name of *Spirillum Zeylanicum*.

TROPICAL BRONCHOMYCOSIS.

During the six years of my residence in Ceylon I have been often struck by the comparatively large number of cases of sub-chronic and chronic bronchitis which on preliminary clinical examination one would suspect to be of tubercular nature, while complete investigation shows constant absence of tubercle bacilli in the sputum, the opthalmic and cuti reactions negative, and inoculation of the sputum into susceptible animals also negative. Some of these cases turned out to be "bronchospirochaetosis," the condition described by me in 1905. In other cases, however, neither spirochaetes nor tubercle bacilli are found, and in a certain number of these cases fungi higher than bacteria are present. These are cases of bronchomycosis. Of this affection in Ceylon I have come across at least 20 cases, basing the diagnosis on the result of the examination of the sputum, and have culturally studied the fungi in four. In Ceylon a mild and a severe type may be distinguished. In the mild type the patient complains of cough with muco-purulent expectoration. There is no fever, the general condition is fairly good; the physical examination of the chest will show nothing at all or a few moist and dry rales. In the severe type the disease closely resembles phthisis. The patient becomes emaciated, there is ectic fever, muco-purulent and bloody expectoration, the physical examination of the chest reveals patches of dullness, fine crepitation and pleural rubbing. I may quote a few cases of each type.

Mild type, Case 1.—Mr. B., a young European tea-taster, has been in Ceylon eight years; never had any disease worth noting. He stays several hours daily in rooms full of tea dust and fluff, and says that he often snuffs various teas, putting a pinch of the teas in his nostrils. Since six months complains of cough with a certain amount of muco-purulent expectoration. No fever; the examination of the chest reveals nothing. Microscopical examination of the sputum for T.B., negative. In fresh preparations a few branching mycelial tubes are visible; rare, free spores.

Treatment.—Ordinary cough mixtures useless; potass. iodid., in large doses, cured the condition in four weeks.

Mild type, Case 2.—Mr. S., a European planter. He has to stay a couple of hours daily in the tea factory. Consulted me in September, 1909, and informed me that he was suffering from what the planters call "tea-factory's cough." He had muco-purulent expectoration. No fever, his general condition fairly good. The microscopical examination of the sputum for T.B. was negative; numerous spores and mycelial tubes of an oidium-like fungus were present.

Treatment.—Potass. iodid., in 15-grains doses four times daily, cured him in three weeks.

Severe type, Case 3.—Mr. M., planter. The sputum had been examined many times for tubercle bacilli by his medical attendants with negative result. When the patient arrived in Colombo he was extremely weak, had serotine fever and bloody expectoration. On examination, fine crepitations and pleural rubbing on both sides. I examined the sputum for tubercle bacilli many times without finding any, and inoculations into guinea-pigs were negative. Fresh preparations always

showed numerous round spores and some mycelial threads. Cultures were made from the sputum on agar and various sugar media. The only germs grown were a hyphomycete with the same morphological characters of that present in the fresh preparation and a streptococcus. The patient became worse and worse. The cough was not relieved by guaiacol, duotal, nor by potass. iodid. He died three weeks after arrival.

Case 4.—Singhalese convict in the Mahara Jail, near Colombo. The symptoms of his disease were at first obscure and various diagnoses, including typhoid, malaria, and phthisis were suggested. The sputum was sent to me several times, but tubercle bacilli were always absent. Instead, a saccharomyces-like and an oidium-like fungus were found. The patient was later transferred to the Clinic for Tropical Medicine, where I kept him under observation for two months. The cough slowly decreased and finally stopped, and the fever completely disappeared. His blood, by means of a Widal-Sicard sporo-agglutination, was shown to contain agglutinins for the cultures of the oidium-like fungus and saccharomyces.

Bacteriological investigation of the fungus found in four cases.

In four cases I plated the expectoration and grew the fungi. In the Mahara Jail case, two fungi, as already stated, were present, a saccharomyces and an oidium; in the other three cases only oidium-like fungi.

Description of the Saccharomyces.—In fresh preparation of the sputum, it appeared as oval roundish budding cells. It was Gram-positive. The cultural characters are collected in the following table:—

The Cultural Characters of the Saccharomyces at 28° C.

Glucose Litmus Broth, 2 per cent.—Acid and gas. Thick pellicle.
 Lævulose Litmus Broth, 1 per cent.—Acid and gas. Thick pellicle.
 Maltose Litmus Broth, 2 per cent.—Practically no change. Thick white pellicle.
 Galactose Litmus Broth, 1 per cent.—Practically no change. Thick white pellicle.
 Saccharose Litmus Broth, 2 per cent.—Practically no change. Thick white pellicle.
 Lactose Litmus Broth, 2 per cent.—Practically no change. Thick white pellicle.
 Mannite Litmus Broth, 2 per cent.—Practically no change. Thick white pellicle.
 Dulcite Litmus Broth, 2 per cent.—Practically no change. Thick white pellicle.
 Dextrin Litmus Broth, 1 per cent.—Practically no change. Thick white pellicle.
 Raffinose Litmus Broth, 1 per cent.—Practically no change. Thick white pellicle.
 Arabinose Litmus Broth, 1 per cent.—No change. Delicate pellicle.
 Nutrose Litmus Broth, 1 per cent.—No change. Very delicate pellicle.
 Inulin Litmus Broth, 1 per cent.—Practically no change. Thick white pellicle.
 Adonite Litmus Broth, 1 per cent.—No change. Delicate pellicle.
 Litmus Milk.—No change.
 Broth.—Clear. Practically no growth. Slight sediment at bottom of tube.
 Peptone Water.—Clear. Practically no growth. Slight sediment at bottom of tube.
 Serum.—White growth. Not liquefied.
 Gelatine.—Not liquefied.
 Agar.—Very thin growth. (Also very thin on Saccharose and Acid maltose agar.)
 Glucose Agar.—Very thick growth. Dead white.

The Cultural Characters of the Saccharomyces at 37° C.

Glucose Litmus Broth, 2 per cent.—Acid and gas. Thick pellicle.
 Lævulose Litmus Broth, 1 per cent.—Acid and gas. Thick pellicle.
 Maltose Litmus Broth, 2 per cent.—Practically no change. Thick white pellicle.
 Galactose Litmus Broth, 1 per cent.—Practically no change. Thick white pellicle.
 Saccharose Litmus Broth, 2 per cent.—Practically no change. Thick white pellicle.
 Lactose Litmus Broth, 2 per cent.—Practically no change. Thick white pellicle.
 Mannite Litmus Broth, 2 per cent.—Practically no change. Thick white pellicle.
 Dulcite Litmus Broth, 2 per cent.—Practically no change. Thick white pellicle.
 Dextrin Litmus Broth, 1 per cent.—Practically no change. Thick white pellicle.
 Raffinose Litmus Broth, 1 per cent.—Practically no change. Thick white pellicle.
 Arabinose Litmus Broth, 1 per cent.—No change. Delicate pellicle. Thick white pellicle.
 Nutrose Litmus Broth, 1 per cent.—No change. Very delicate pellicle.
 Inulin Litmus Broth, 1 per cent.—Practically no change. Thick white pellicle.
 Adonite Litmus Broth, 1 per cent.—No change. Delicate pellicle.
 Litmus Milk.—No change.
 Broth.—Clear. Thin pellicle. Slight sediment at bottom of tube.

Peptone Water.—Clear. Slight sediment at bottom of tube. Practically no growth.
 Serum.—White growth. Not liquefied.
 Agar.—Very thin growth. (Also very thin on Saccharose and Acid maltose agar.)
 Glucose Agar.—Very thick growth. Dead white.

Description of the Oidium-like Fungi.

In fresh preparations of sputum septate mycelial tubes, 3-4 micron in breadth, are seen, at the terminal end of each of which two to four shorter ovoid elements can often be observed; numerous free oval roundish spores, 4-8 micron, are also observed. Gram staining positive. On ordinary agar and various sugar agars the fungi grow abundantly producing roundish thick white creamy colonies which later fuse together. The culture characters in various sugar media are collected in the following tables in one of which, for comparison purposes, the culture characters of the saccharomyces are repeated.

The Cultural Characters of Oidium (Strain 1) at 28° C.

Glucose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Abundant growth at bottom of tube.
 Lævulose Litmus Broth, 1 per cent.—Acid and gas. No pellicle. Abundant growth at bottom of tube.
 Maltose Litmus Broth, 2 per cent.—Acid. Gas in four days. No pellicle. Abundant growth at bottom of tube.
 Galactose Litmus Broth, 1 per cent.—Acid. Slight gas after eleven days. No pellicle. Fairly abundant growth at bottom of tube.
 Saccharose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Abundant growth at bottom of tube.
 Lactose Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Mannite Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Dulcite Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Dextrin Litmus Broth, 1 per cent.—No change. Fairly abundant growth at bottom of tube.
 Raffinose Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Arabinose Litmus Broth, 1 per cent.—No change. Fairly abundant growth at bottom of tube.
 Nutrose Litmus Broth, 1 per cent.—No change. Slight growth at bottom of tube.
 Inulin Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Adonite Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Litmus Milk.—No change.
 Broth.—Clear. Very slight sediment. No growth (?)
 Peptone Water.—Clear. Very slight sediment. No growth.
 Serum.—Creamy growth, surrounded by a zone of yellowish-pink colour. Not liquefied.
 Gelatine.—Not liquefied.
 Agar.—Very thin moist growth.
 Glucose Agar.—Very thick wax-like growth. (Also very thick on Saccharose and Acid maltose agar.)

The Cultural Characters of Oidium (Strain 1) at 37° C.

Glucose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Abundant growth at bottom of tube.
 Lævulose Litmus Broth, 1 per cent. Acid and gas. No pellicle. Abundant growth at bottom of tube.
 Maltose Litmus Broth, 2 per cent.—Acid. Gas in two days. No pellicle. Abundant growth at bottom of tube.
 Galactose Litmus Broth, 1 per cent.—Acid and very slight gas. No pellicle. Fairly abundant growth at bottom of tube.
 Saccharose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Abundant growth at bottom of tube.

Lactose Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Mannite Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Dulcitate Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Dextrin Litmus Broth, 1 per cent.—No change. Fairly abundant growth at bottom of tube.
 Raffinose Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Arabinose Litmus Broth, 1 per cent. No change. Fairly abundant growth at bottom of tube.
 Nutrose Litmus Broth, 1 per cent.—No change. Slight growth at bottom of tube.
 Inulin Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Adonite Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Litmus Milk.—No change.
 Broth.—Clear. Fine (thin) pellicle. Slight sediment.
 Peptone Water.—Clear. Thin pellicle. Slight sediment.
 Serum.—Creamy growth, surrounded by a zone of yellowish-pink colour. Not liquefied.
 Agar.—Thin white moist growth.
 Glucose Agar.—Very thick wax-like growth. (Also very thick on Saccharose and Acid maltose agar.)

The Cultural Characters of Oidium (Strain 2) at 28° C.

Glucose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth.
 Lævulose Litmus Broth, 1 per cent.—Acid and gas. No pellicle. Good growth.
 Maltose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth.
 Galactose Litmus Broth, 1 per cent.—Acid and gas. Fair growth. No pellicle.
 Saccharose Litmus Broth, 2 per cent.—Acid and gas. Good growth. No pellicle.
 Lactose Litmus Broth, 2 per cent.—No change. Slight growth at bottom of tube.
 Mannite Litmus Broth, 2 per cent.—No change. Slight growth at bottom of tube.
 Dulcitate Litmus Broth, 2 per cent.—No change. Slight growth at bottom of tube.
 Dextrin Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Raffinose Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Arabinose Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Nutrose Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Inulin Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Adonite Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Litmus Milk.—No change.
 Broth.—Clear. Practically no growth.
 Peptone Water.—Clear. Practically no growth. No pellicle.
 Serum.—Growth white and with the serum under the growth and immediately surrounding of a distinct reddish colour. Not liquefied.
 Gelatine.—Not liquefied.
 Agar.—Very thin white moist growth.
 Glucose Agar.—Thick white wax-like growth. (Also very thick on Saccharose and Acid maltose agar.)

The Cultural Characters of Oidium (Strain 2) at 37° C.

Glucose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth.
 Lævulose Litmus Broth, 1 per cent.—Acid and gas. No pellicle. Good growth.
 Maltose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth.
 Galactose Litmus Broth, 1 per cent.—Acid and gas. No pellicle. Fair growth.
 Saccharose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth.
 Lactose Litmus Broth, 2 per cent.—No change. Slight growth at bottom of tube.
 Mannite Litmus Broth, 2 per cent.—No change. Slight growth at bottom of tube.
 Dulcitate Litmus Broth, 2 per cent.—No change. Slight growth at bottom of tube.
 Dextrin Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Raffinose Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Arabinose Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.

Nutrose Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Inulin Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Adonite Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Litmus Milk.—No change.
 Broth.—Clear. Very slight pellicle. Practically no growth.
 Peptone Water.—Clear. Practically no growth.
 Serum.—Growth white and shining, with the serum under the growth and immediately surrounding of a distinct reddish colour. Not liquefied.
 Agar.—Very thin white growth.
 Glucose Agar.—Thick growth. White, waxy surface. (Also very thick on Saccharose and Acid maltose agar.)

The Cultural Characters of Oidium (Strain 3) at 28° C.

Glucose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Lævulose Litmus Broth, 1 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Maltose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Galactose, Litmus Broth, 1 per cent.—Acid after ten days.
 Saccharose Litmus Broth, 2 per cent.—Acid and gas produced after four weeks.
 Lactose Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Mannite Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Dulcitol Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Dextrin Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Raffinose Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Arabinose Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Nutrose Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Inulin Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Adonite Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Litmus Milk.—No change.
 Broth.—Clear. Slight sediment. No growth (?).
 Peptone Water.—Clear. Slight sediment. No growth.
 Serum.—White growth. Slight pigmentation surrounding bottom of growth after ten days. Not liquefied.
 Gelatine.—Not liquefied.
 Agar.—Very thin moist, white growth.
 Glucose Agar.—Very thick, wax-like growth. (Also very thick on Saccharose and Acid maltose agar.)

The Cultural Characters of Oidium (Strain 3) at 37° C.

Glucose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Lævulose Litmus Broth, 1 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Maltose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Galactose Litmus Broth, 1 per cent.—Acid in five days. No gas.
 Saccharose Litmus Broth, 2 per cent.—Acid and gas in five days.
 Lactose Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Mannite Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.

Dulcite Litmus Broth, 2 per cent.—No change. Very slight growth at bottom of tube.
 Dextrin Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Raffinose Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Arabinose Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Nutrose Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Inulin Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Adonite Litmus Broth, 1 per cent.—No change. Very slight growth at bottom of tube.
 Litmus Milk.—No change.
 Broth.—Clear. Slight sediment. Practically no growth.
 Peptone Water.—Clear. Slight sediment. Practically no growth.
 Serum.—White growth. Slight pigmentation surrounding bottom of growth after ten days. Not liquefied.
 Agar.—Very thin white growth.
 Glucose Agar.—Thick white, wax-like growth. (Also very thick on Saccharose and Acid maltose agar.)

The Cultural Characters of Oidium (Strain 4) at 28° C.

Glucose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Lævulose Litmus Broth, 1 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Maltose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Galactose Litmus Broth, 1 per cent.—Slight acidity. No pellicle. Good growth at bottom of tube.
 Saccharose Litmus Broth, 2 per cent.—No change in seven days. Acid eleventh day.
 Lactose Litmus Broth, 2 per cent. No change. Fair growth at bottom of tube.
 Mannite Litmus Broth, 2 per cent.—No change. Fair growth at bottom of tube.
 Dulcite Litmus Broth, 2 per cent.—No change. Fair growth at bottom of tube.
 Dextrin Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Raffinose Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Arabinose Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Nutrose Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Inulin Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Adonite Litmus Broth, 1 per cent.—No change. Fair growth at bottom of tube.
 Litmus Milk.—No change.
 Broth.—Clear. Slight sediment. No growth (?)
 Peptone Water.—Clear. Slight sediment. No growth.
 Serum.—Whitish growth. Not liquefied.
 Gelatine.—Not liquefied.
 Agar.—Thin white moist growth.
 Glucose Agar.—Very thick, wax-like growth. (Also very thick on Saccharose and Acid maltose agar.)

The Cultural Characters of Oidium (Strain 4) at 37° C.

Glucose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Lævulose Litmus Broth, 1 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Maltose Litmus Broth, 2 per cent.—Acid and gas. No pellicle. Good growth at bottom of tube.
 Galactose Litmus Broth, 1 per cent.—Acid, no gas. No pellicle. Good growth at bottom of tube.
 Saccharose Litmus Broth, 2 per cent.—Acid. Slight gas at 11th day. No pellicle. Good growth at bottom of tube.

Lactose Litmus Broth, 2 per cent.—No change. Good growth at bottom of tube.
Mannite Litmus Broth, 2 per cent.—No change. Good growth at bottom of tube.
Dulcite Litmus Broth, 2 per cent.—No change. Good growth at bottom of tube.
Dextrin Litmus Broth, 1 per cent.—No change. Good growth at bottom of tube.
Raffinose Litmus Broth, 1 per cent.—No change. Good growth at bottom of tube.
Arabinose Litmus Broth, 1 per cent.—No change. Good growth at bottom of tube.
Nutrose Litmus Broth, 1 per cent.—No change. Good growth at bottom of tube.
Inulin Litmus Broth, 1 per cent.—No change. Good growth at bottom of tube.
Adonite Litmus Broth, 1 per cent.—No change. Good growth at bottom of tube.
Litmus Milk.—No change.
Broth.—Clear. Slight sediment. Practically no growth.
Peptone Water.—Clear. Slight sediment. Practically no growth.
Serum.—Whitish growth. Not liquefied.
Agar.—Thin white moist growth.
Glucose Agar.—Very thick wax-like growth. White. (Also very thick on Saccha-
rose and Acid maltose agar.)

Cultural Reactions at 37° C. after 14 days.

	Glucose.	Lævulose.	Maltose.	Galactose.	Saccharose.	Lactose.	Mannite.	Dulcite.	Dextrin.	Raffinose.	Arabinose.	Nutrose.	Inulin.	Adonite.	Litmus Milk.	Broth.	Peptone Water.	Liquefaction of Serum.	Liquefaction of Gelatine.	Indole.
Oidium Strain I.	A.G.	A.G.	A.G.	A.G.*	A.G.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.†	O.†	O.	O.	O.
Oidium Strain II.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.†	O.†	O.	O.	O.
Oidium Strain III.	A.G.	A.G.	A.G.	A.	A.G.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.‡	O.‡	O.	O.	O.
Oidium Strain IV.	A.G.	A.G.	A.G.	A.	A.G.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.‡	O.‡	O.	O.	O.
Saccharomyces ..	A.G.	A.G.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.	O.†	O.†	O.	O.	O.

A. = Production of acid. G. = Production of gas. O. = No change.
* = Very slight gas. † = Thin pellicle. ‡ = Practically no growth.

From the table it is seen that the four strains of oidium isolated are identical in all their culture characters except that No. 1 and No. 2 produce acid and gas in galactose while strains 3 and 4 produce only acidity. This differential character has always remained constant although we have repeated the reactions several times. All the four strains are different from the ordinary oidium albicans and oidium lactis as they have no action on milk, at least, for three weeks. As far as I know the saccharomyces I have found is different from any other saccharomyces as yet described.

Conclusions.—A type of Bronchomycosis in which oidium-like and Saccharomyces-like fungi are found is not rare in Ceylon. The condition might be called Tropical Bronchooidiomycosis or more briefly Bronchooidiosis.

2. Two types of the condition may be clinically distinguished—a mild one and a severe one, the latter closely resembling phthisis. The mild type is apparently amenable to Potass. Iodid. treatment.

3. The strains of oidia found in my cases are different from the ordinary oid. albicans and lactis, as they do not affect milk.

4. All the strains found by me are identical with each other except that some produce gas in galactose and others do not. For the oidium which produces gas in galactose I propose the name *Oidium tropicale*; for the oidium which does not produce gas in that sugar medium the name of *Oidium para tropicale*. For the Saccromyces I suggest the name *Saccromyces krusei*.

5. The diagnosis of Broncho-oidiosis can be made only by bacteriological methods. It is made from phthisis by the absence of tubercle bacilli and the negative animal inoculations; from broncho-spirochætes by the absence of spirochætes and from endemic hæmophthysis by the absence of the ova of the specific worm.

6. Care should be taken before making the diagnosis of bronchomyosi that the sputum is collected in sterile vessels and examined as soon as possible, because sputa left exposed to the air become frequently contaminated in the tropics by various species of non-pathogenic saccharomyces and oidia.

No. 3.

CEYLON.

REPORT ON THE RESEARCH WORK DONE IN THE CLINIC FOR TROPICAL DISEASES AND BACTERIOLOGICAL INSTITUTE FROM 1ST JANUARY TO 30TH JUNE, 1910, BY ALDO CASTELLANI, M.D.

(Received 29 August, 1910.)

During the last six months I have carried out some researches on "Anchylostomiasis Fever," and I have continued the investigation on "Tropical Bronchooidiosis."

"ANCHYLOSTOMIASIS FEVER."

Fever in patients suffering from Anchylostomiasis has been noted by several authors—among whom Bozzolo, Manson, and more recently Gabbi, who has emphasized the frequent occurrence of the phenomenon.

In Ceylon—fever is very frequently met with in anchylostomiasis patients. Among the anchylostomiasis patients admitted to the Clinic it has been observed in about 25 per cent. of the cases of medium gravity, and in 50 to 75 per cent. in very serious cases.

Types of fever.

Commonest of all is a low-intermittent type; the temperature rises above normal in the late morning, reaches its maximum in the evening, and falls down at night between 11 p.m. and 2 a.m. The maximum of the fever seldom exceeds 101. The onset of the attack is not marked by shivering, or any chilly sensation. The defervescence at night is not associated with sweatings. The patient does not as a rule complain of feeling feverish; in fact this low fever apparently does not give rise to any subjective symptom. This type of low-intermittent fever may last for several months, but occasionally the temperature may be normal for a few days. It is not influenced by quinine or any antipyretic drug.

After an energetic treatment for the anchylostoma the fever stops—though as a rule not immediately, but after a period of time varying from a few days to three or four weeks.

Besides the intermittent type, which is the commonest, other types of fever may be met with in anchylostomiasis patients, viz., the subcontinuous or continuous type, an irregular type and, rarely, a peculiar undulant type. In the subcontinuous and continuous types the fever seldom exceeds 101 or 102: the temperature is a little lower in the morning but does not drop to normal; the fever is not associated with any marked subjective symptoms; it generally stops ten to thirty days after an energetic treatment for the anchylostoma. Occasionally a very irregular type of fever—at times intermittent, at times subcontinuous—is observed. The undulating type, somewhat similar to Malta fever, I have observed in two cases: the fever gradually increases daily, then it gradually decreases till the temperature becomes normal, or nearly so; after two or three days of practically normal temperature another period of fever develops similar to the first; the second attack of fever is followed by a few days of normal temperature; then a third period of fever develops, and so on for months.

Origin of Anchylostomiasis Fever

In none of my cases was the fever due to a malarial, a typhoid, paratyphoid, or Malta fever infection—the blood of all patients having been repeatedly examined microscopically and bacteriologically. The fever—which in all cases had been most persistent and had lasted for several months—dropped in all cases, except one, between a few days to four weeks after an energetic treatment for the worm by means of beta naphthol, thymol, or chloroform-eucalyptus mixture.

In 1904 I expressed the opinion that the fever so frequently met with in anchylostomiasis patients is not due to the worm itself—nor probably to its toxins—but to secondary infections due to intestinal bacteria and taking place through the

minute wounds produced in the mucosa by the parasites. I have during the last six months made an attempt to elucidate the origin of the fever by making a comparative study of the intestinal flora in anchylostomiasis patients and in normal individuals, and by studying microscopically and bacteriologically (serum reactions, &c.) the blood of anchylostomiasis patients.

Comparative investigation of the Intestinal Bacterial Flora of six anchylostomiasis patients and six normal natives.

Before commencing this investigation I had a fair knowledge of what the usual intestinal flora in normal people in Ceylon is, having studied it in eleven healthy individuals in 1909.* I considered, however, that it would be of advantage to repeat the investigation on several more normal individuals fed on the same diet as the anchylostomiasis patients.

Technique.

The stools were collected in large sterile petri dishes and plated almost immediately, using ordinary agar-agar. The plates were incubated at 35 c. for 48 hours, after which a certain number of colonies (9, 10 or 11 for each individual) taken at random were further investigated. The investigation was limited to the ærobic germs of the family *bacteriæceæ*.

The details of the investigation of the six anchylostomiasis patients are collected in the following tables:—

* Report of the Advisory Committee for the Tropical Diseases Research Fund for the year 1909, page 101, [Cd. 4999].

ANKYLOSTOMIASIS STOOLS.

Table 1.

Abbreviations used in the tables :—

G. = Gas. C. = Clot. G.T. = General turbidity. P. = Pellicle. S. = Slight.
A. = Acid. O. = Negative result, viz. :—Neither acid nor gas in sugar media, non-production of indole, non-motile or serum as the case may be.
+ = Positive result. Alk. = Acid, then alkaline.

No.	Motility.	Litmus milk.	Lactose.	Saccharose.	Dulcité.	Mannite.	Glucose.	Maltose.	Dextrin.	Raffinose.	Arabinose.	Adonite.	Inulin.	Galactose.	Laevulose.	Indole.	Gram.	Gelatine.	Serum.	Peptone water.	Broth.	Voges-Prosk.
1	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.	O.
2	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.	O.
3	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	G.T.P.	O.
4	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	G.T.P.	O.
5	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.	O.
7	+	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.	O.
8	O.	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.	O.
9	O.	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.	O.
10	O.	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.	O.
11	O.	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.	O.

Table 2.

1	+	A. Alk.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	O.
2	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	O.
3	+	A. Alk.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	O.
4	+	A.C.	A.G.	O.	O.	A.G.	A.G.	O.	A.G.	O.	O.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	O.
5	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	O.
6	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	O.
7	+	A.C.	A.G.	O.	O.	A.G.	A.G.	O.	A.G.	O.	O.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	O.
8	+	A.C.	A.G.	O.	O.	A.G.	A.G.	O.	A.G.	O.	O.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	O.
9	+	A.C.	A.G.	O.	O.	A.G.	A.G.	O.	A.G.	O.	O.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	O.
10	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	O.	O.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	O.

ANKYLOSTOMIASIS STOOLS.

Table 3.

No.	Motility.	Litmus milk.	Lactose.	Saccharose.	Dulcite.	Mannite.	Glucose.	Maltose.	Dextrin.	Raffinose.	Arabinose.	Adonite.	Inulin.	Galactose.	Laevulose.	Indole.	Gram.	Gelatine.	Serum.	Peptone water.	Broth.	Voges-Prosk. reaction.
1	0	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.S.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
2	+	A.C.	A.G.	0.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
3	+	A.C.	A.G.	0.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
4	+	A.C.	A.G.	A.G.	0.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	A.G.S.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
5	0	A.C.	A.G.	A.G.	0.	A.G.	A.G.	A.G.	A.S.G.S.	A.G.	A.G.	A.G.S.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
6	0	A.C.	A.G.	A.G.	0.	A.G.	A.G.	A.G.	A.G.S.	A.S.G.S.	A.G.	A.G.S.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
7	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
8	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
9	+	A.C.	A.G.	A.G.S.	A.G.S.	A.G.S.	A.G.	A.G.	A.G.S.	A.S.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
10	0	A.C.	A.G.	0.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.

Table 4.

1	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
2	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
3	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	A.G.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
4	0	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
5	+	A.C.	A.G.	A.G.S.	A.G.S.	A.G.S.	A.G.	A.G.	A.S.G.S.	A.S.G.S.	A.G.	A.G.S.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
6	+	A.C.	A.G.	A.G.S.	A.G.S.	A.G.S.	A.G.	A.G.	A.S.G.S.	A.S.G.S.	A.G.	A.G.S.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
7	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
8	0	A.C.	A.G.	0.	A.G.	A.G.	A.G.	A.G.	A.S.	A.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
9	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.
10	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	0.	0.	A.G.	A.G.	+	0.	0.	0.	G.T.	G.T.P.	0.

ANKYLOSTOMIASIS STOOLS.

Table 5.

No.	Motility.	Litmus milk.	Lactose.	Saccharose.	Dulcite.	Mannite.	Glucose.	Maltose.	Dextrin.	Raffinose.	Arabinose.	Adonite.	Inulin.	Galactose.	Laevulose.	Indole.	Gram.	Gelatine.	Serum.	Peptone water.	Broth.	Voges-Prosk. reaction.
1	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	G.T.P.	O.
2	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	G.T.P.	O.
3	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	G.T.P.	O.
4	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	G.T.P.	O.
5	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	G.T.P.	O.
6	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	G.T.P.	O.
7	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	G.T.P.	O.
8	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	G.T.P.	O.
9	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	G.T.P.	O.
10	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	G.T.P.	O.

Table 6.

1	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	G.T.P.S.	O.
2	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	G.T.P.S.	O.
3	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	G.T.P.S.	O.
4	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	G.T.P.S.	O.
5	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	G.T.P.S.	O.
6	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	G.T.P.S.	O.
7	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	G.T.P.S.	O.
8	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	G.T.P.S.	O.
9	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	G.T.P.S.	O.
10	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	G.T.P.S.	O.

The details of the investigation of the stools of the six normal natives—who had the same diet as the anchylostomiasis patients—are found in the following tables :—

NORMAL STOOLS.

Table 1.

Abbreviations used in the tables :—
A. = Acid. G. = Gas. D. = Decolourised. G.T. = General turbidity. P. = Pellicle. S. = Slight.
O. = Negative result, viz. :—Neither acid nor clot in milk, neither acid nor gas in sugar media, non-production of indole, non-motile, or non-liquefaction of gelatine or serum as the case may be.
+ = Positive result.

No.	Motility.	Litmus Milk.	Lactose.	Saccharose.	Dulcite.	Mannite.	Glucose.	Maltose.	Dextrin.	Raffinose.	Arabinose.	Adonite.	Inulin.	Galactose.	Laevulose.	Indole.	Gram.	Gelatine.	Serum.	Peptone water.	Broth.	Voges-Prosk. reaction.
1	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.P.S.	G.T.P.S.	O.
2	+	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.S.	O.
3	O.	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.S.	O.
4	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.S.	O.
5	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.S.	O.
6	O.	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.S.	O.
7	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.P.S.	G.T.P.S.	O.
8	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.P.S.	G.T.P.S.	O.
9	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.P.S.	G.T.P.S.	O.
10	O.	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.P.S.	G.T.P.S.	O.

Table 2.

1	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.D.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.	O.
2	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.D.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.	O.
3	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.D.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.	O.
4	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.D.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.	O.
5	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.S.	A.G.	O.D.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.	O.
6	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.D.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.	O.
7	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.D.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.	O.
8	O.	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.	O.
9	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.	O.
10	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.D.	A.G.	A.G.	A.G.	+	O.	O.	G.T.	G.T.P.	O.

NORMAL STOOLS.

Table 3.

No.	Motility.	Litmus milk.	Lactose.	Saccharose.	Dulcité.	Mannite.	Glucose.	Maltose.	Dextrin.	Raffinose.	Arabinoz.	Adonite.	Inulin.	Galactose.	Laevulose.	Indole.	Gram.	Gelatine.	Serum.	Peptone water.	Broth.	Voges-Prosk. reaction.
1	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	O.	G.T.	O.
2	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	O.	G.T.	O.
4	+	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	O.	G.T.P.	O.
5	O.	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	O.	G.T.	O.
6	O.	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	O.	G.T.	O.
7	+	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	O.	G.T.	O.
8	+	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	O.	G.T.	O.
9	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	O.	G.T.	O.
10	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.D.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	O.	G.T.	O.
11.	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.D.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	O.	G.T.	O.

Table 4.

1	+	A.C.	A.G.	A.G.S.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.	O.
2	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	O.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.	O.
3	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	A.G.	O.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	O.
4	+	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.P.S.	O.
5	+	D.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	O.
6	O.	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	O.
7	+	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	O.
8	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	O.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	O.
9	O.	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	O.
10	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	A.G.	O.	O.	O.	A.G.	+	O.	O.	O.	O.	G.T.	O.

NORMAL STOOLS

Table 5.

No.	Motility.	Litmus milk.	Lactose.	Saccharose.	Dulcite.	Mannite.	Glucose.	Maltose.	Dextrin.	Raffinose.	Arabinose.	Adonite.	Inulin.	Galactose.	Laevulose.	Indole.	Gram.	Gelatine.	Serum.	Peptone water.	Broth.	Voges-Prosk. reaction.
1	+	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.S.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
2	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
3	+	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.S.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
4	+	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
5	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	D.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
6	+	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
7	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
8	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
9	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
10	+	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.S.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.

Table 6.

1	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
2	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
3	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
4	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
5	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
6	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
7	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
8	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
9	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
10	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.

The following two tables show the result of the investigation of ankylostomiasis patients in comparison with those of normal individuals :—

COMPARATIVE STOOLS.

(A.) *Ankylostomiasis Stools.*

Abbreviations used in the tables :—

G. = Gas. G. = Clot. G.T. = General turbidity. P. = Pellicle, S. = Slight.
 O. = Negative result, viz. :—Neither acid nor gas in sugar media, non-production of indole, non-motile or non-liquefaction of gelatine or serum as the case may be.
 + = Positive result. + = Sometimes positive, sometimes negative. A = Acid, then Alkaline. Alk. = Alkaline.

	No. identified out of 66 colonies investigated.	Cultural Characters.															Broth	Voges-Prosk. reaction.				
		Motility.	Litmus milk.	Lactose.	Saccharose.	Dulcife.	Mannite.	Glucose.	Maltose.	Dextrin.	Raffinose.	Arabinose.	Adonite.	Inulin.	Galactose.	Laevulose.			Indole.	Gram.	Gelatine.	Serum.	Peptone water.
<i>B. asiaticus.</i> (Castellani.)	6	O.	Alk.	O.	A.G.S.	O.	A.G.	A.G.	A.G.	A.S.G.S.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	+	O.	G.T.	G.T.P.S.
<i>B. grüntali.</i> (Castellani.)	12	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	G.T.P.
<i>B. coli communis.</i> (Escherish.)	2	+	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.S.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.
<i>B. coli immobilis.</i> (Durham.)	3	O.	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.
<i>B. neapolitanus.</i> (Emmerich.)	6	O.	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.
<i>B. pseudo coli.</i> (Castellani.)	19	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.
<i>B. paratyphus B.</i> (Schoftmüller.)	2	+	A. Alk.	O.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.
<i>B. oxyfucus perniciosus.</i> (Wyssokowitsch.)	1	O.	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.S.G.S.	A.G.	A.G.	O.	O.	O.	O.	G.T.	G.T.P.S.
Similar to <i>B. acidi lactici.</i> (Htippe.)	2	O.	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.
Similar to <i>B. lactis aerogenes.</i> (Escherich.)	5	O.	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.S.	A.G.	A.G.	A.G.S.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.
Similar to <i>B. para entericus.</i> (Castellani.)	8	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.	G.T.P.

(B.) Normal Stools.

	No. identified out of 60 colonies investigated.	Cultural Character.																Broth.	Voges-Prosk. reaction.				
		Motility.	Litmus milk.	Lactose.	Saccharose.	Dulcife.	Mannite.	Glucose.	Maltose.	Dextrin.	Raffinose.	Arabinose.	Adonite.	Inulin.	Galactose.	Laevulose.	Indole.			Gram.	Gelatine.	Serum.	Peptone water.
<i>B. grüntali.</i> (Castellani.)	6	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.S.	G.T.P.	O.
<i>B. coli communis.</i> (Escherich.)	8	+	A.C.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.S.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.	O.
<i>B. neapolitanus.</i> (Escherich.)	6	O.	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.	O.
<i>B. pseudo coli.</i> (Emmerich.)	12	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
Similar to <i>B. pseudo coli.</i> (Castellani.)	2	+	A.C.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	O.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.S.	O.
Similar to <i>B. grüntali.</i> (Castellani.)	7	+	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.P.S.	G.T.P.	O.
Similar to <i>B. acidilactici.</i> (Hüppe.)	5	O.	A.C.	A.G.	O.	O.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.	O.
Similar to <i>B. cloacae.</i> (Jordan.)	8	+	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O. ¹	O. ¹	G.T.	G.T.P.	O.
Similar to <i>B. lactis aerogenes.</i> (Escherich.)	6	O.	A.C.	A.G.	A.G.	O.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.	O.	A.G.	A.G.	+	O.	O.	O.	G.T.	G.T.P.	O.

The above two tables show that there is very little difference between the intestinal flora of anchylostomiasis patients and that of normal natives.

Bacteriological investigation of the blood of anchylostomiasis patients.

The blood of 11 anchylostomiasis patients presenting fever was examined microscopically for malaria, and by serum reactions and cultural methods for Malta fever, typhoid, paratyphoid. The results were always negative. The blood of the eleven anchylostomiasis patients with fever was investigated culturally as to its sterility. No germ was grown except in one case. The germ grown in this case was a bacillus which I called *b. Asiaticus*. It was also isolated from the stools of the same patient. The blood of most anchylostomiasis patients presented agglutinins for some intestinal bacteria. For instance, case 3 and case 4 agglutinated up to a dilution of 1 in 250, the *b. pseudocolon* isolated from their stools, and also strains of pseudocolon isolated from other patients and normal people; their blood did not influence any other intestinal germ except in dilution of less than 1 in 10. The other anchylostomiasis patients presented no agglutinating power for strains of bacillus pseudocolon. The blood of case 1, from whom *bacillus Asiaticus* was isolated, agglutinated this germ in a dilution of 1 to 200. It did not agglutinate any other intestinal germ except in dilution of less than 1 in 20. This case was rather interesting, and a few more particulars may be given. The patient was a Singhalese boy, 11 years of age, with well-marked signs of anchylostomiasis, general œdema, extreme pallor of the palpebral conjunctiva, &c. There was fever of low-intermittent type, the daily maximum reaching about 101—said to have been present for four months. The stools contained numerous eggs of anchylostoma. An eucalyptus-chloroform treatment repeated three times cured the anchylostomiasis, but the fever continued of the same low-intermittent type. Two months after the last antihelmintic treatment, considering that the fever was probably due to the germ isolated from the patient's blood, I prepared a vaccine, and I injected with it the patient twice; the first time the temperature only rose a little and the course of the fever was not influenced. The second time—a week later—three hours after a larger injection the temperature rose to 105, the patient becoming very sick. The day after the fever stopped completely. Whether the dropping of the fever was really due to the injection cannot be said with certainty, but there is a strong probability of this being so. I may say that this was the only case of anchylostomiasis fever in which the temperature lasted so long after the antihelmintic treatment.

Conclusions.

1. Fever is frequently observed in anchylostomiasis.
2. The fever is generally of a low-intermittent type, occasionally sub-continuous, continuous, or irregular; very rarely it presents an undulant character.
3. The origin of the fever is not clearly known; but according to my experiments it would seem that in some cases it is probably due to secondary infections brought about by intestinal bacteria, which may enter the general circulation through the minute wounds induced by the worm or may cause localized inflammatory and minute purulent changes in and around the lesions produced by the anchylostoma.
4. There is not much difference between the ærobic bacterial flora of anchylostomiasis patients and that of normal individuals; but it is very probable that under certain circumstances ordinary intestinal bacteria such as, for instance, the *C. pseudocolon*, may become virulent and pathogenic. Only in one of my anchylostomiasis patients was the fever probably due to a germ (*bacillus Asiaticus*) which I have not yet observed in normal fæces.

FURTHER RESEARCHES ON "TROPICAL BRONCHOIDIOSIS."

In my report for the second half-year 1909, I gave the results of an investigation on a type of bronchitis—very common in Ceylon—due to an oidium. At that time I had observed about twenty cases, the diagnosis being based on the microscopical examination of the expectoration. In four cases I had grown the fungus, using maltose and other sugar agars. During the last few months I have come across several other cases; I have grown the fungus in three more, and I have been able to make some comparative studies of the various strains. As I have already mentioned in my previous report a mild and a severe type of the malady may be distinguished. In the mild type the general condition of the patient is fairly good, there is little or no fever, and he simply complains of cough—with muco-purulent expectoration. The physical examination of the chest will reveal a few coarse

moist rales, or in some cases nothing at all. The condition may last several weeks, and even months. A potass. iodid. treatment (grains xv three times daily) is of great advantage.

The following is an example of this type of the malady, taken among my recent cases :—

Mrs. N., a European lady living in a very hot and damp district of Ceylon for the last four years, consulted me three weeks ago. Since three months complains of cough with scarce muco-purulent expectoration, mostly in the morning. General condition fairly good. The examination of the chest reveals nothing. Examination of the sputum : T.B. negative—oidium-like fungus present in large amount, and easily grown on sugar agars. Saiodin was prescribed (grains x three times daily). I have received a letter a few days ago to the effect that she is much better and the expectoration has completely stopped.

The severe type of the disease closely resembles phthisis. The patient becomes emaciated; there is ectic fever, muco-purulent and bloody expectoration : occasionally true hæmoptysis occurs, a tea-spoonful or more of bright blood being spat at a time. The search for T.B. is always negative, the inoculation into animals is also negative. The physical examination of the chest shows patches of dulness, fine crepitations, and pleural rubbing. This type is often fatal, no treatment being of much use. Of this variety of the malady I quoted a typical case in my last report.

Recently I have come across several cases of medium gravity. These often present with bronchial and broncho-alveolar symptoms a type of subcontinuous or continuous fever. As an example of this type of the malady I may quote the following case which I have kept under observation in the Seamen's ward for some time.

Singho Appu.—Sinhalese man, 23 years of age. Admitted to the seamen's ward on the 31st March, 1910, with history of continuous fever and cough said to be of two weeks' duration. On admission the general condition of the patient is fairly good. Temperature 101, pulse 96. The patient has frequent attacks of cough, but the expectoration—which is muco-purulent—is not abundant. The physical examination of the chest reveals a few ronchi and some coarse, moist rales both sides; at the right base there is a small patch where the resonance is slightly impaired, and some subcrepitant rales are heard; a similar small patch with the same signs is found in the left infrascapular region. Nothing worth noting as regards the circulatory and digestive system; the oral mucosa does not show signs of thrush.

Special examinations.

Sputum.—Examination for T.B. repeated several times negative. The microscopical examination of the fresh preparations shows a large amount of a fungus, numerous spores and some mycelium being present. The fungus (see table, strain VI.) is easily grown, using maltose and other sugar agars. A few cocci and short bacilli are present : true pneumococci apparently absent.

Blood.—Widal and bile blood cultures negative; sporoagglutination for the fungus positive.

Course.—The temperature gradually decreased to normal. There were no sweatings or shivering fits. The condition of the respiratory organs gradually improved, the patches of diminished resonance becoming normal. The expectoration, which had never been very abundant, decreased rapidly, and the fungus disappeared.

The fungus.—In fresh preparations of the sputum spore-like, round or oval cells 4-6 microns are seen, and portions of mycelial tubes. The fungus is gram-positive. If a particle of the sputum be smeared on maltose or glucose agar plates, after two or three days numerous white, roundish colonies appear, easily distinguished even macroscopically with a little practice, from the colonies of cocci, &c. The fungus colonies are further investigated by inoculating various sugar agars and sugar broths. On solid media the six strains I have isolated are identical : their growth is comparatively scarce on ordinary alkaline agar, while it is very abundant, thick and of white creamy colour in the various acid sugar agars. The best media are, perhaps, Sabouraud and glucose agars. On these media the growth on the slope consists principally of globular cells similar to a yeast, while in the water of condensation globular cells and mycelial articles are generally present together. A little mycelium may, however, occasionally be found also in the growth on the slope.

From the above table it will be seen that all the seven strains are practically identical, except that some produce acid and abundant gas in galactose, while others produce in that medium acid but only a trace or perhaps no gas at all. The strains are different from the common *oidium albicans* (the thrush fungus) and *oid. lactis*; in contrast to these—among other differential characters—they have no action on milk (30 days).

Conclusions.

1. A type of bronchitis in which an *oidium* is present in the expectoration is of common occurrence in Ceylon.

2. The fungus is probably the true cause of the disease, as in my cases no other ætiological agent such as tubercular bacilli, &c., could be found. Moreover, when the patient gets better the fungus becomes very scarce or disappears completely.

3. The *oidium* infection apparently attacks directly the bronchi, as none of my patients presented lesions due to *oidia* in the mouth or pharynx.

4. The *oidium*, as shown by its culture characters, seems to be a new species, for which I suggested the term "*Oidium Tropicale*." The pathological condition caused by it might be called "*Tropical Bronchooidiosis*." In my previous report I classified the strains isolated into two groups, those producing gas in galactose and those not producing gas in that medium. Further investigation has shown that under certain circumstances all strains may produce a little gas in galactose, and therefore this distinction into two groups is not correct.

5. The diagnosis of tropical bronchooidiosis is based on bacteriological methods. The condition is distinguished from pulmonary tuberculosis by the absence of the tubercle bacillus, the negative animal inoculations, and the negative result of the cuti—and ocular—reactions; from "*Bronchospirochætosis*" by the absence of spirochætes; from endemic hæmopthisis by the absence of ova of the specific worm (*Paragonimus Westermani* Kerbert).

6. Before making a diagnosis of "*Bronchooidiosis*," care should be taken to ascertain that the expectoration was collected in sterile petri dishes, because in a tropical country sputum exposed to the air quickly becomes contaminated with various fungi. Primary bronchooidiosis should also be distinguished from the secondary bronchooidiosis occasionally met with in cachetic patients suffering from cancer, diabetes, tuberculosis, &c., and presenting thrush lesions on the oral mucosa. In these cases the ordinary thrush fungus (*Oidium Albicans*) may occasionally spread from the oral mucosa to the respiratory organs.

I desire to express my thanks to Mr. E. Burgess, the Assistant Bacteriologist, for the valuable assistance he has rendered during the course of the researches which form the subject of this report.

ALDO CASTELLANI.

July, 1910.

No. 4

EAST AFRICA PROTECTORATE.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 9 May, 1910.)

Government House, Nairobi,

MY LORD,

British East Africa, April 11th, 1910.

WITH reference to my despatch of the 6th of October last,* I have the honour to transmit herewith the report of the work done in the Nairobi Laboratory for the half-year ending the 31st of December, 1909, together with a covering letter from the Principal Medical Officer.

I have, &c.,

E. P. C. GIROUARD,

Governor.

* See p. 117 of [Cd. 4999].

Enclosure in No. 4.

Principal Medical Officer's Office,
Nairobi, 29th March, 1910.

SIR,

I HAVE the honour to forward the bi-annual report on the work of the Nairobi Bacteriological Laboratory for the six months ending December 31st, 1909.

Research work proper during this period has been much interrupted by two factors—a vastly increased demand for a free supply of vaccine owing to an outbreak of small-pox which filtered through the country, the manufacture of which of a necessity took up a great deal of the time of Dr. Ross and his assistant; and the chemical examination of numerous water supplies.

Research work has been confined to attempting to repeat Dr. Kleine's experiments with *Glossina palpalis*, with *Glossina fusca* and *pallidipes*. These experiments are not yet completed. Dr. Ross's work on the leucocytozoon of the guinea fowl has been continued, and would appear to confirm the work of Neave and Wenyon at Khartum on the same subject. As regards the disease M'Kebbe, it will be noticed that he is not in agreement with the opinion expressed by Colonel Sir David Bruce and Dr. Theiler, that this disease is identical with East Coast fever.

The major portion of the report is taken up with an interesting discussion on the waters of East Africa, with a number of analyses appended.

I have, &c.,

A. D. MILNE,

Principal Medical Officer.

The Secretary
to the Administration,
Nairobi.

EXTRACT FROM THE SECOND REPORT OF THE NAIROBI BACTERIOLOGICAL LABORATORY
FOR THE YEAR 1909, BY DR. P. H. ROSS.

NAIROBI LABORATORY REPORT, July 1-December 31, 1909.

During the past six months the routine work of the laboratory has very much increased, the total number of examinations made being nearly four times as great as during the first six months of the year. The large number of water analyses that have had to be done and the greatly increased demand for vaccine lymph have made a large demand on one's time. Mr. Montgomery, the veterinary bacteriologist, arrived in August, but, his own laboratory not being ready, he has spent most of his time in the districts, and the routine diagnostic veterinary work has still been done in this laboratory. Fortunately, the veterinary laboratory assistant has become sufficiently expert with the microscope to be able to do most of this work, referring to me when in doubt or when wanting confirmation of his diagnosis. But for this, the addition of some 1,100 veterinary examinations to the increased medical work would have made it impossible to keep pace.

Work has been continued with *Glossina pallidipes* and *Glossina fusca* and various trypanosomes, but so far without result. Work with the leucocytozoon of the guinea fowl was interrupted by a constant succession of water analyses, which rendered impossible continuous use of the microscope.

Blood examinations and Malaria.

Of 372 blood examinations, 49 showed malaria. Thirty of these were cases of sub-tertian, 14 of benign tertian, and two were mixed infections, one of benign and sub-tertian, and one of quartan and sub-tertian.

Out of 216 differential leucocyte counts, 24 showed an increase of large mononuclear leucocytes with the presence of pigment. These cases must also be regarded as malarial. The total result is that 19.0 per cent. of all bloods examined were malarial.

An increase of eosinophiles is rather commonly seen; an increase above 5 per cent. being seen in 35 cases. Twenty-four of these cases were Indians; only four being Europeans and six Africans.

Leprosy.

Two cases of leprosy were seen. The first was that of a native, and in this case scanty acid fast bacilli were found in the discharge from a sore.

The second case was that of an European. In this case attempts were made to demonstrate the bacilli by the method of Marchoux and Borret. This method consists in taking blood smears from the neighbourhood of a leprous lesion, fixing by burning a drop or two of absolute alcohol on the slide, staining with warm carbol fuchsin, decolourizing with 10 per cent. nitric acid, and counter staining for a second with borax blue to colour the leucocytes. The bacilli are looked for in the large mononuclear leucocytes where these are most numerous, that is to say, the sides and ends of the preparation. In the case tried, no bacilli were found by this method, but it was probably not a fair test, as the case was one of almost pure anæsthetic leprosy. The bacilli were demonstrated in the nasal discharge and also in scrapings from anæsthetic erythematous patches. It would be interesting to make a series of examinations by the method of the French writers on cases of nodular leprosy. If the method proves a success, it has the advantage of being simple, easily carried out, and of doing away with the exception that may be taken to the examination of the nasal discharge—that the bacilli found may be some other acid—fast bacilli and not the *B. lepræ* at all.

Perhaps some medical officer who sees much of the disease would examine a series of cases, or would send smears from cases to the laboratory for examination.

Vaccine.

29,430 tubes of vaccine have been issued, being sufficient for more than 100,000 vaccinations. On the whole the results have been apparently good, the only complaints of failure having been received from Kisumu, from Marsabit, on the northern frontier, and from an out-station in Uganda. I am at a loss to explain the bad results with several issues of lymph to Kisumu. In one case, lymph from the same calf was used with success at the laboratory to vaccinate another calf at the time that the issue to Kisumu was made. In other cases I had no such control; but even the results of vaccinations at Kisumu were in some instances very contradictory. A possible explanation is that after a certain time in the ice-chest the lymph is still active when used at once, but that it becomes less resistant to high temperatures, such as would be met with at Kisumu, when it has been some time removed from the ice, even though every effort may be made to keep it cool.

So far as concerns Marsabit and Uganda, prolonged sojourn in a hot post-bag on the back of a porter in a blazing sun is sufficient to account for loss of activity in any glycerinated calf lymph. In the case of Marsabit, it takes a month for the post to arrive; and it would be surprising if any of the lymph were active at the end of such a journey. I hope that now I have the means of overcoming this difficulty by using the method, described by Achalme and Marie Phisalix, of drying the lymph in vacuo and sealing in tubes, also in partial vacuo. If lymph so prepared keeps its activity in the manner described by these authors, I propose to make sufficient to issue to all out-stations. Such lymph could then be kept in stock, and, in the case of an outbreak of small-pox, would serve to vaccinate contacts and to carry on vaccination until further supplies of fresh lymph could be obtained from the laboratory. It could also be used as the usual supply for distant stations where the glycerinated lymph gives bad or no results. Two strains of lymph have been manufactured and issued. One was the strain derived from the Lister Institute, the other was that started by Dr. Small from cases of small-pox. There seems to be no difference between these two strains. Both have given usually good results, and, in the case of the bad results at Kisumu, both strains had been supplied.

Plague.

No cases of plague occurred in Nairobi, but infected rats were sent from Nakuru for examination.

Smears from the sputum of a case of pneumonic plague were also sent from Nakuru.

Dr. Arthur, of the Scotch Mission at Kikuyu, sent smears made from the puncture of buboes in two cases, and, in these, bacteria morphologically indistinguishable from the *B. pestis* were found.

In the spleens of two cases which died in the Native Hospital, Nairobi, bacteria resembling the *B. pestis* were found. Cultures were made, and the growths resembled those of plague bacilli, except that no stalactite formation could be got. Involution forms on salt agar were obtained. The cutaneous reaction on a guinea pig was tried, but without result. In both cases some time had elapsed between death and the carrying out of the post-mortem examination, so that it is probable that the bipolar bacilli met with were only putrefactive organisms.

Koch-Week's bacillus.

In smears from the discharge in a case of conjunctivitis, bacteria were found indistinguishable from the Koch-Week's bacillus (*B. ægyptiacum*).

Search for Malta fever among goats.

Thanks to the kindness of Sir David Bruce, the laboratory became possessed of a strain of *Micrococcus melitensis*. I have examined many goats for an agglutinative reaction with this strain. The sanitary inspector in charge of the slaughter-house kindly took a tube of blood from every goat slaughtered, and these bloods were tested in a dilution of 1-20. No reaction was found in 263 goats examined. The work was interrupted by water analysis, but the fact that the reaction has been found in Uganda makes it appear worth while to continue the search in this Protectorate. I do not think that goats' milk is much used by white people in this country, but anyone using it would be well advised to boil such milk before use, as a precautionary measure.

Various work.

Among the miscellaneous work brought to the laboratory there have been such things as the weighing of coins for the Treasury, and the estimation of acidity in fruit. The fruit was a species of *Flacourtia* very common in the Kavirondo country, and the question was its suitability for coagulating rubber. When the fruit reached the laboratory, it was somewhat fermented. The juice was expressed by squeezing through cloth, and the acidity of the juice determined. One kilo. of the fruit yielded 700 c.c. of juice, which showed an acidity equal to 4 c.c. of glacial acetic acid in 100 c.c. of juice. If this is a sufficient degree of acidity for the purpose, the fruit should be a cheap substitute for lemons and oranges. If the acidity is insufficient, it might be worth while trying whether the acidity could be increased by fermentation, without damage to its coagulating properties. A slight degree of fermentation, such as the sample sent showed, would probably make the expression of the juice easier.

Trypanosomiasis.

Experiments have been begun with *T. gambiense* and a trypanosome from a mule, and *Glossina fusca* and *Glossina pallidipes* on the lines of Kleine's experiments. In these experiments, made with captured flies, the most important consideration is the exclusion of naturally infected flies. To ensure this, two animals are used for the flies to feed on before the experiment proper begins. The first animal is used to feed flies until a sufficient number have been collected for the experiment. These flies are then fed on another animal for from eighteen days to three weeks, then starved for four days, fed on an infected animal for four days, again starved for four days and then fed on the experimental animal.

For the second time, the animal on which the flies were fed when first brought to the laboratory has become infected, and again the infective fly has been the *Gl. pallidipes*. The previous case was in 1904, when the feeding of 85 flies during a period of 60 days resulted in the infection of the animal 70 days after feeding had been begun. In this last case 209 flies were fed between July 15 and December 10.

Another trypanosome met with was found in a mule which had been recently imported from the north. This trypanosome closely resembled morphologically

T. nanum, but it is distinguished from it and from *T. vivax* and *T. cazalboui*, the group as described by Montgomery and Kinghorn, by the fact that it is extremely fatal to dogs, which die about a fortnight after inoculation with it. There is, therefore, a difference between this trypanosome and the one conveyed by *Gl. pallidipes* from Kibwezi.

Blood parasites of the Guinea fowl and Spur fowl.

In my report for 1908 I described and figured what I called leucocytozoa in the Guinea fowl and Spur fowl. I find that similar, if not identical, parasites have been described by Neave and Wenyon in the reports of the Khartum laboratory. During the past six months I have had several guinea fowl infected with this parasite in the laboratory, in hopes of being able to work at the life history. All that has been possible, however, has been to observe the parasites in fresh and stained specimens, and I find that Wenyon's account is so full that there is little to add. The point on which I am still unconvinced is his contention that the host cell is an erythrocyte. There certainly are large greenish oval cells in birds' blood, which may very likely be altered red cells, but I find that the nucleus of the host cell in this disease is very often larger than any nucleus I have seen in these presumably altered red cells. In my guinea fowl, even when showing a very high infection, I have found very little variation in the size of the parasites, but, in a spur fowl which showed numbers of parasites indistinguishable from those of guinea fowl, I have also seen many smaller forms, and it is the appearance of these latter forms which makes me doubtful as to the identity of the host cell.

In these smaller forms the picture usually consists entirely of parasite and nucleus of host cell. The latter is varying in size, but is always larger than the nucleus of a normal erythrocyte, and usually larger than the nucleus of one of these abnormal red cells. Further, it is often very irregular in outline, being indented by the parasite or folded round it. But in these smaller forms there is seldom any trace of host cell apart from the nucleus, whereas, were this cell one of the altered erythrocytes, one might expect to see at any rate a small portion of the cell not yet filled with the parasite, as is the case with *Halteridium*. When any unoccupied portion of the host cell is visible, it stains a pale blue, as would the protoplasm of a leucocyte.

One must further presuppose that these altered red cells are entirely deprived of hæmoglobin to account for the absence of pigment or other debris, the result of destruction of hæmoglobin.

The infected guinea fowl I have been observing have also had a high infection of *Halteridium*, which promptly flagellated when the blood was drawn, but the leucocytozoon were also present in large numbers. After a couple of hours, the free flagella were usually no longer visible, while the changes that I observed in the leucocytozoon often did not take place till the blood had been drawn for a considerable time.

In the case which showed the highest infection with leucocytozoa, four or five parasites could often be seen in one field. No locomotion was ever observed on the slide, but in some of the parasites there was a kind of peristaltic movement. The most noticeable thing about the movement was the slow flowing of the refractile granules within the parasite. These were usually grouped at the two ends of the parasite, but were sometimes seen to gradually move, first towards one end and then towards the other. At the same time, close observation showed that a kind of peristaltic wave kept passing from one end of the parasite to the other, and then back again. Wenyon describes this movement, and also the appearance of protruberances, not large enough to be called pseudopodia, from the side of the parasite. I have found that the peristaltic movement, with the movement of the granules, can be observed in many of the parasites, but by no means in all, whilst the appearance of a projection on the surface is much more rarely seen, and is the precursor of further changes, which result in the escape of the parasite from the host cell. This escape I have observed several times, but not nearly so often as one would expect, considering the numbers of parasites that have been watched. I soon found that what looked like a large, and therefore probably full-grown, parasite might be watched for hours, that the granules would continue moving,

but that no further change took place unless the parasite had also exhibited the formation of these slight projections when first taken under observation.

The projection usually occurred a little to one side of the middle of the parasite on the side opposite the nucleus of the host cell. Very slight at first, it kept disappearing and appearing, getting gradually larger. When it reached a size that stood out as a distinct projection, it became permanent, getting a little smaller but not entirely disappearing. At this stage it could be observed that the granules were flowing in and out of the projection. The projection increased in size till it formed three parts of a circle, when it gradually became constricted at its base, and finally, when all the granules had flowed into it, it appeared to become entirely separate from the rest of the cell, or, at most, joined to the cell by the thinnest of thin threads. After this had occurred, no further change was seen, even when the parasite was watched for several hours. Several of the preparations were carefully smeared off, the blood allowed to dry, and then stained with giemsa. In the stained specimen many unaltered parasites were seen, as well as a few which had apparently undergone the change described. In these latter, the nucleus of the host cell could be clearly made out, and round it could be seen the envelope of the host cell, looking like a burst bladder. The parasite lay beside the remnants of the host cell, sometimes apparently free, sometimes connected to the remains of the cell by a faint thread.

In all the fresh preparations examined there was no variation in shape in the parasites. They were always definitely spindle shaped, and the only variation was in size, and, even in this, the variation was small.

In the stained specimens, however, there were very marked variations in shape, which must have been the result of spreading the smear. Two types, as described by Neave and Wenyon—the deeply stained very granular female and the lighter stained less granular male—were quite obvious; but in all, comparing them with the fresh specimens, there was an evident flattening of the parasite. Judging by the very uniform appearance of the fresh specimens, practically all the variations in shape seen in the stained specimens must be attributed to the spreading of the film preparatory to staining.

Smears were made from the internal organs of one infected guinea fowl which died. In both fresh and stained preparations, the parasites were found, usually showing no difference from the forms seen during life, but there was a large proportion of free parasites. Many of these were apparently still contained in the host cell, others were closely applied to the remains of the cell, and only in a very few could no trace of the cell be seen. When free or close outside the host cell, the parasite appeared as an irregular oval—the usual shape when still within the host cell—or as a circular body resembling the escaped parasite as seen in a fresh preparation when the escape of the parasite has been observed. In the guinea fowl which showed the highest infection of leucocytozoa there was also a very high infection of *Halteridium*. The latter flagellated as soon as the blood was drawn, and the most obvious thing seen in a fresh preparation was the violent agitation of the pigment in the parasites which had already become spherical. In a few minutes several flagella would be protruded; when all were protruded, the interior of the cell came to rest, but the cell itself would then be violently agitated by the lashing movements of the flagella. Gradually the flagella would escape, and then the picture was that of an intense trypanosome infection. For an hour or more the flagella could be seen actively moving about the field, often several being seen attacking the red blood corpuscles. But, though carefully watched, no flagellum was ever seen to attack a cell infected with *Halteridium*. The most marked thing about the free flagella was their ærotropism. Any air bubble in the preparation was surrounded by numbers of flagella, all in active movement. Occasionally flagella could be seen attacking a leucocytozoon, but this was very rare, and the flagellum was never seen to penetrate, whereas, in the case of red cells, flagella could frequently be seen, which had either penetrated the cell, or were so closely applied to it as to appear as if they had penetrated. One of Wenyon's figures (No. 27, Plate XVI., Third Report Wellcome Laboratory) resembles what I have seen in stained specimens from this doubly infected bird when the blood had been kept for some time, either under a cover glass or in a damp cell, before being spread; but I have never seen any sign of flagellation occurring in the leucocytozoa, nor, indeed, of any further change than that described above as extrusion of the parasite from the host cell.

M'Kebbe.

In my report for the year 1905, I described, under the name of "M'Kebbe," a disease which appears to be common among calves throughout the country. As the Sleeping Sickness Commission in Uganda and Dr. Theiler, who recently passed through the country, have come to the conclusion that this disease is neither more nor less than East Coast fever, it would seem worth while to reprint that part of my 1905 report, which was the first account of the disease. I add this as an appendix.

It is, of course, possible that the Commission and Dr. Theiler have had to do with a different disease from the one I described four years ago, but I am quite clear that the cases I then saw were not Coast fever. I first met cases of Coast fever in 1904, and came across the "blue body" in November of that year, and looked for it, and found it, in every case of the disease that I saw after that date. I also found, during the year 1905, in the cases that I described as M'Kebbe, peculiar bodies in the peripheral blood and in the glands by puncture during life, and in the liver, spleen, and lung, post mortem. Yet I saw no reason to consider that the diseases were really one and the same.

One point of difference was that M'Kebbe was a wasting disease, the carcase after death being distinctly emaciated. In Coast fever, on the other hand, the animal is usually in good condition, and may look well till a day or two before death. As regards the blue bodies, the appearance in fresh specimens was distinctly different. The M'Kebbe body was hard to see, and the most remarkable thing about it was the active dancing movements of the granules. In Coast fever the granules are larger in size, and have not got this dancing movement.

In the stained specimen the Coast fever body is a much more prominent object than the M'Kebbe body. The masses of chromatin are larger, and often more numerous, and the protoplasm takes on a much darker blue than does the protoplasm of the M'Kebbe body. As regards occurrence in the various organs, both bodies are found in glands and the inner organs, but I have not seen the M'Kebbe body in anything like the numbers in which the Coast fever body usually occurs. Infarction is much less marked in M'Kebbe than in Coast fever. Further, the M'Kebbe body can, by long search, be found in the peripheral circulation. In the hundreds—probably thousands—of Coast fever slides that I have examined since 1904, I have only three times seen the blue body in the peripheral blood, and in those three cases the bodies were so distinctly Coast fever bodies that I should probably have excluded M'Kebbe even without the high infection of ring and rod parasites. The absence of ring and rod intracorpuseular parasites in my cases of M'Kebbe was another point of difference. In the prolonged search through blood smears to find the M'Kebbe bodies, one must certainly have found these intracorpuseular forms had they been present, especially as I was then very familiar with their appearance, and always on the look out for them, in order to find out if Coast fever were spreading.

Another point against the identity of the two diseases is, that if they are one and the same, the country round Nairobi, and possibly the whole Protectorate, must be an endemic centre of Coast fever. M'Kebbe was known to Mr. Stordy some years before Coast fever was discovered here, and, since its discovery, the spread has been followed. It is certainly true that there have been cases which seemed to show that the local cattle had some degree of immunity, but, on the other hand, the mortality has been very much higher than one would expect from an endemic disease, immunity to which was due to previous attack and recovery. The wholesale destruction of cattle by rinderpest between eleven and twelve years ago should have left large areas destocked for long enough for them to become clean. Even though the cattle brought in from surrounding countries might have been immune, they would have been unable to reinfect such country as had become clean, and until the disease was reintroduced, the only immunity would be that of the imported cattle and a possible hereditary immunity in their progeny.

APPENDIX 1.

EXTRACT FROM LABORATORY REPORT FOR 1905.

For some years Mr. Stordy, Chief Veterinary Officer, has been acquainted with a disease among calves, known in Uganda as M'Kebbe, and in this Protectorate

under various native names. The disease is characterised by fever, enlargement of superficial lymphatic glands, especially the cervical and precrural, wasting, and often death. An opportunity occurred of studying the disease in the case of a calf sent in to us from the Government farm, Nairobi. The animal did not appear particularly ill, but it showed large groups of glands the size of a pear on both sides of the neck. The temperature was found to be high (v. chart*). The animal ate well but grew constantly thinner, and finally died, with subnormal temperature.

During life a gland was punctured with a large hypodermic needle, and fluid drawn up into a syringe. In a fresh preparation made from this fluid numbers of dancing granules, resembling blood dust, were seen among the normal glandular elements. Groups of 6-8 of these granules were noticed to keep together, and on careful focussing and lighting, it was seen that each group was contained within a clear circular body of definite outline. Within the limits of this body the granules continued to move; some of them singly, others in pairs. Although watched for some considerable time, no sign of amœboid movement in the large bodies was observed, nor were they seen to undergo any further change.

On staining with Leishman smears made from the gland juice, circular bodies, varying in size from that of a red corpuscle to that of a white cell, were seen. They showed a faintly stained protoplasm containing a few (3-6) small, irregularly placed chromatin dots.

In the peripheral blood, long search showed similar bodies. The relative number found in gland and blood is comparable to the number of trypanosomata found in gland and blood in *Trypanosomiasis hominis*.

Post-mortem examination.

The calf was much emaciated. The superficial glands, especially cervical and precrural, were much enlarged. On section, their appearance was natural, except the one which had been punctured, which was hæmorrhagic. The lung showed small infarcts along the edges. The heart had a little jelly-like material round the apex. The spleen was enlarged, but not to the extent seen in Texas fever. Mesenteric glands were slightly enlarged. The other organs appeared natural.

Smears of liver, spleen, and infarction areas in the lungs showed the blue bodies as described. This was the only animal in which we were able to follow the disease for any time, but opportunities occurred of making post-mortem examinations on three more fatal cases, and of getting gland juice from two more living animals. The post-mortem appearances were exactly as described, and the blue bodies were also found. In a blood smear from another calf these bodies were discovered; and it was found that the animal from which the smears were taken had enlarged cervical glands.

Disease among Goats in the Kibwezi district.

During the year, it was reported that goats were dying near Kibwezi. It was not possible to see the animals myself, but my Indian assistant, Compounder Pillay, saw a number of the affected animals. He reported that he found the goats with high temperature and enlarged superficial glands. On making a post-mortem examination, he found some jelly-like material in the pericardium, and infarcts in the lung; the spleen and other organs were apparently normal. In blood smears I found scanty bodies resembling those found in M'Kebbe, but showing more chromatin dots, and very much resembling a sporulating body. No intracorpuseular bodies could be found.

No. 5.

EAST AFRICA PROTECTORATE.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 6 October, 1910.)

Government House, Nairobi,

MY LORD,

British East Africa, September 1st, 1910.

WITH reference to my despatch of the 11th of April,† I have the

* Not reproduced.

† No. 4.

honour to submit herewith the Bacteriologist's Report for the half-year ending the 30th of June, 1910, together with a covering letter from the Principal Medical Officer.

I have, &c.,

E. P. C. GIROUARD,
Governor.

Enclosure in No. 5.

Principal Medical Officer's Office, Nairobi,

SIR,

31st August, 1910.

I HAVE the honour to forward Dr. Ross's Laboratory Report for the half-year ending June 30th.

Despite the fact that a large portion of his time is taken up with routine examination work, water analysis, and the manufacture of vaccine lymph, the experiments on the lines of Kleine's work—to infect *Glossina fusca* with trypanosome gambiense—have been continued with, again, negative results.

He records the existence of what is probably a new sarcosporidium in East African cattle; also a blood parasite in the dog, which, if not new, may be Bentley's leucocytozoon.

It is of interest to note that two of the preparations of "sour milk" were found to be inactive.

I have, &c.,

A. D. MILNE,
Principal Medical Officer.

The Secretary to the Administration,
Nairobi.

NAIROBI LABORATORY REPORT.*

January-June, 1910.

The work of the laboratory during the past six months has closely resembled that of the preceding period. For the last three months of the time my assistant was absent on leave, and his absence threw practically the whole of the routine work on myself. There have been a number of water analyses, and in six cases bacteriological as well as chemical analyses have been called for.

There has been a constant demand for vaccine, nearly 25,000 tubes having been issued. As will be seen, a practical experiment testing the keeping power at high temperature of lymph dried and stored *in vacuo* has been a great success.

Experiments have been continued with tsetse fly and various trypanosomes, but still without any positive result.

There have been two discoveries of parasites, new at any rate in this country. One of these is a blood parasite of the dog, which may be the leucocytozoon described by Bentley. The other is a sarcocyst in the ox, which is peculiar in not being visible to the naked eye nor even with a hand lens.

Malaria.

In 97 examinations malarial parasites were found, and in a further 24 cases there was an increase of large mononuclear leucocytes with the presence of pigment. Seventy-eight of these cases were subtertian or tropical malaria.

These figures were considerably higher than ever before. When the cases are distributed to the various months and then compared with the rainfall for the period, the connection between the two becomes striking, as will be seen from the following table and diagram. In order to make the results as complete as possible, I have added the figures for the last quarter of 1909. Excluding four showers not sufficient to wet the ground, earlier in the month, the small rains began on October 28th,

* The diagrams, photographs, &c., referred to are not reproduced.

1.55 inches falling during the last four days of the month. The beginning of the rainy season thus preceded the height of the malarial epidemic by about two months.

Month.					Number of wet days.	Total rainfall.	Cases of malaria.
1909.							
October ...	...	...	...	...	4 (last of month)	1.55	3
November ...	...	...	...	...	18	7.2	6
December ...	...	...	...	...	19	5.83	15
1910.							
January ...	...	...	...	...	7	3.07	29
February ...	...	...	...	...	1	0.04	27
March ...	...	...	...	...	5	1.27	13
April ...	...	...	...	...	17	5.07	12
May ...	...	...	...	...	13	5.96	12
June ...	...	...	...	...	3	1.03	16

Vaccine.

24,293 tubes of glycerinated lymph were issued during the six months. To overcome the loss of virulence due to exposure to high temperatures in transit, an attempt was made to adopt the method suggested by Achalme and Marie Phisalix. Lymph collected on November 29th, 1909, was dried over sulphuric acid in a partial vacuum created by a water pump. The dried fragments were put into tubes, the air exhausted, and the tube sealed in the flame. The sealed tubes were kept at room temperature.

On December 14th Dr. Milne, Principal Medical Officer, took one of these tubes with him on a six weeks' tour, a great part of the journey being through some of the hottest parts of the Protectorate. The tube was carried in his despatch box. Not having occasion to use the lymph, he returned the tube to me in April last, and it lay on the laboratory table till the end of June, when Dr. Lowsley kindly undertook to try it in the gaol. He mixed the dried lymph (less than 1 gm.) with a little water, and with the emulsion vaccinated 107 prisoners. There was no selection of subjects, these 107 being prisoners who had recently been brought to the gaol from out-stations. Dr. Lowsley tells me that he had 98 successes among the 107 vaccinations, that although in many cases there appeared to be some modification, there were several successful and typical results.

These figures appear highly satisfactory, and this method of preparation should solve the difficulty of supplying lymph to such stations as Marsabit and Kismayu. It should even be possible to supply distant out-stations with a reserve to tide over the time between an outbreak of small-pox and the arrival of fresh lymph from the laboratory.

The disadvantages of this method of preparation are that it is much more troublesome and that if less than 1 gm. is sufficient to vaccinate 107 people with five insertions to each case it is impossible to put up tubes containing sufficient for three or four vaccinations as is the custom with glycerinated lymph. Whatever lymph was not used at the time of opening the tube would probably become rapidly useless.

Filariasis.

Dr. Lowsley took blood smears from 200 prisoners in the gaol between the hours of 9 p.m. and 11 p.m. These smears I examined for filaria, and in 10 (5%) *microfilariae* were found. Five showed *F. perstans*, and five *F. nocturna*. It was not possible to classify the cases according to tribes, but this has since been done for 500 prisoners, and the results will be given in the next report. In the case of blood examinations from patients in the native hospital, I have so far always found that it was only in those from Kavirondo and Uganda that *microfilaria* were found, and then only *F. perstans*.

Water Analyses.

Twenty-one chemical analyses of water and soda water were carried out. In six instances bacteriological examinations were also undertaken, four of soda water, one of the Nairobi supply, and one of Nairobi river water. The first two analyses

of soda water samples from the local factories gave bad results, especially bad when compared with the entirely satisfactory result of the examination of the Nairobi supply from which the soda water was manufactured. As the samples were taken from the factory soon after manufacture and examined at once, it could not be argued in excuse that the bacteria had multiplied in the bottles. The results of the second examination carried out after the manufacturers had been warned to set their houses in order gave entirely satisfactory results.

Widal Reactions.

Thirty-one Widal reactions were done, of which twenty-five were negative. The six positive results came from cases in or near Nairobi.

Examination of Preparations of "Sour Milk" Bacteria.

Two preparations of lactic acid bacilli were brought to the laboratory. One preparation was "lacto-bacilline," the other "desiccated granules of Bulgarian sour milk ferment." It may be of interest to the local practitioner to know that I did not succeed in getting a growth from either preparation, although I tried quantities varying from those given in the accompanying instructions up to very large doses. A little clotting could be observed at the bottom of the culture tubes when a large amount had been added, but the medium remained sterile.

VETERINARY WORK.

Sarcosporidiosis of Cattle.

During Mr. Montgomery's absence in the out-stations the supervision of his assistant, as on previous occasions, fell to me. While he was away in German East Africa, sarcosporidia were found in the heart of an ox. The heart had been sent by a farmer near Nairobi, and blood smears were made from the muscle in order to look for piroplasmata. None were found, but the smear was full of typical spores of a sarcosporidium. On finding these the heart was carefully examined again for cysts, but none were visible even with the aid of a hand lens. Further smears from the heart muscle, however, always showed quantities of the spores, and in a fresh preparation a thin-walled cyst full of spores, some of which were escaping through a rent in the cyst wall, could be seen with a two-thirds inch objective.

Some of the tissue was hardened, and sections were cut and stained. On examining these sections it was found that there were very numerous cysts either in or between the muscle fibres. The cysts were either elongated with somewhat pointed ends, or, when cut in cross sections, round. The average size was $140\mu \times 35\mu$. There was a very delicate cyst wall, but no trace of any striated envelope.

The spores are best examined in smears made from the heart muscle and stained with Giemsa. There are found to be two types, a sausage-shaped or oval form $14\mu \times 6\mu$, and a more elongated form $18\mu \times 4\mu$, which is distinctly more pointed at one end. The distribution of the chromatin is the same in both forms. At one end, the pointed end in the case of the long forms, there is a dense mass of chromatin completely filling the end, no protoplasm being visible between the chromatin and the edge of the parasite. At the other end is another mass of chromatin, which is not, however, terminal. Protoplasm can be clearly seen all round it, and the appearance of the chromatin is quite different to that at the other end. The latter stains deeply and uniformly, the former takes a paler stain, and has deeply-stained granules of chromatin scattered throughout. In only a very few was this granular appearance not marked; when it was not apparent the staining was uniform, as in the case of the terminal mass, but not so deep.

In the fresh preparation no movement could be seen, and the only difference in appearance from the stained specimens was that even the shorter forms appeared more pointed at one end than at the other.

The peculiarities of this sarcocyst would seem to be its small size and the delicate nature of the cyst wall. I can find no mention of a sarcocyst that was not visible to the naked eye; yet in two cases where microscopical examination had shown that the parasite was present, most careful subsequent examination failed to reveal

the cysts even with the aid of a hand lens. Sections of the affected heart muscle, however, showed the presence of 102 cysts in a portion of tissue 1 cm. long by $\frac{1}{2}$ cm. wide. Since the end of the half-year, Mr. Patrick, Sanitary Inspector, has kindly taken smears of the heart muscle of all oxen slaughtered at the local slaughter-house. Although there was nothing that he could see (visibly affected organs would be sent to the laboratory) in twelve out of twenty-seven oxen spores of a sarcocyst have been found. Mr. Montgomery, on his return from German East Africa, told me that he had been shown the spores but not the cysts from cattle near the south end of the Victoria Nyanza. The parasite would appear to have a wide distribution throughout the country. That it has escaped recognition up till now must be due to the small size of the cysts.

Blood Parasite of the Dog.

In an animal which had been used to feed *Glossina fusca*, a blood parasite was found. Nothing abnormal had been found in the blood during life, but after death a few bodies were found. The majority of these were free and showed a definite circular or oval outline, blue-stained (Giemsa) protoplasm and one or more masses of chromatin. Figures 1, 2, and 3 show the usual distribution of the chromatin. Only one example of Fig. 4 was found. In this there was a deeply-stained protoplasmic ring, and a large mass of rather lightly-stained chromatin in the centre. One end of this mass was fairly deeply stained, but the other end was almost clear, with a few minute chromatin granules scattered throughout. Fig. 5 shows a large mononuclear leucocyte, in which a parasite fills up the whole of the space not occupied by the nucleus and even overlaps the nucleus with one corner. No other leucocyte could be found showing a clear parasite. Fig 6 is of a red corpuscle, which shows the comparative sizes of red cell and parasite.

Experiments in transmitting Trypanosomes with Glossina fusca.

Five experiments have been carried out with *Glossina fusca* on the lines of Kleine's experiments.

The results of the experiments have always been negative, but it is impossible to accept these results as conclusive. In the first place, the number of flies surviving long enough to become infected, even were they capable of infection, was too small. It is known that only a small percentage of *Glossina palpalis* fed on an infected animal become infective. In the second place, there is always the possibility of a trypanosome infection remaining unrecognised. Only by frequent subinoculation could such an unrecognised infection be excluded.

The full details of the experiments are given later; what appear to be the important points are given separately below.

Experiment 1.—The experimental monkey died on the 14th day, on which flies were fed on it, this being the 10th day after the flies had first fed on the infected monkey. The period is too short for development in the fly and infection in the animal to have taken place.

No monkey being available to feed the surviving flies, they were fed on a dog (181). This dog lived for four months, and, although its temperature chart was suspicious, no trypanosomes could ever be found. On its death, another dog (201) was inoculated from it, and died on the 11th day. Again no trypanosomes could be found, but the chart in this case did not make one suspect infection.

Apparently in this experiment the flies used were not infected with trypanosomes on arrival. Had they been infected, the dog (174) on which they fed on arrival until sufficient flies had been collected, the monkey on which they were fed for three weeks before feeding on the infected animal, and the experimental animal, all had time to show an infection, but none could ever be found.

Experiment 2.—Unfortunately in this experiment only two flies survived for 18 days after first biting the infected monkey. The result for these flies is clearly negative, the monkey (182) being still alive. The flies used appear not to have been naturally infected as the monkey on which they fed for 18 days (180) before biting the infected monkey is still alive.

Experiment 3.—Experiment 3 was an attempt to infect *Glossina fusca* with a trypanosome coming originally from a mule. In this experiment trypanosomes could never be found in the experimental animals (193 and 206). The temperature

chart and the appearance of the first animal made one suspect trypanosomiasis, but a sub-inoculation was negative.

As in the previous experiments the flies used do not appear to have been naturally infected.

Experiment 4 (T. gambiense).—In this experiment no evidence of a natural trypanosome infection could be found. The experimental animal (208) survived for four months, but trypanosomes could never be found.

Experiment 5.—No evidence could be found of natural infection of the flies used. In the experimental animal (220), trypanosomes could not be found.

Transmission Experiments with Glossina fusca.

Experiment 1.

Does *Glossina fusca* which has fed on an animal infected with *T. gambiense* become infective?

Dog 174.—*Glossina fusca* were fed on arrival on dog 174 ("collection dog"). From July 23rd to July 26th, 32 flies were fed on this dog. The animal survived for 3 months, showed no trypanosomes in its blood during life, and no signs of trypanosomiasis post-mortem. It was also used as "collection dog" in experiment 2, being bitten by 32 flies between August 24th and August 25th.

Monkey 175. "Fresh fly monkey."—From July 28th to August 16th monkey 175 was bitten 275 times by the flies which had survived after feeding on dog 174. The animal died on the 24th day. Trypanosomes were never found in its blood, nor were there any signs of trypanosomiasis post-mortem.

Monkey 176.—This monkey was infected with *T. gambiense*. The flies surviving from monkey 175 were fed on this animal on August 18th, 19th, and 20th, the animal being bitten 40 times.

Monkey 178, "experimental monkey."—The flies surviving from monkey 176, after 3 days' starvation, were fed on monkey 178, which was bitten 135 times between August 23rd and September 4th. The animal died on September 5th—too soon for one to expect any result, nor could any signs of trypanosomiasis be found. The flies were then—no monkey being available—put to feed on dog 181.

Dog 181 was bitten 140 times between September 7th and October 3rd, when the last two flies died. The dog survived for 3 months after the fly feeding had ceased, but, although the temperature chart appeared rather suspicious, no trypanosomes could be found, nor were there any signs of trypanosomiasis post-mortem. From the heart's blood of this dog, dog 201 was inoculated.

Dog 201, inoculated from dog 181, died on the 10th day, showing no trypanosomes nor signs of trypanosomiasis post-mortem.

Conclusion.—The conclusion is negative, but the only animal that lived long enough to be of any use was dog 181. This animal showed occasional rises of temperature, but no trypanosomes could be found, and there were not the low morning temperatures usual in trypanosomiasis. The temperature of dogs in this country is very unstable, due probably to their all being infected with *P. canis*.

The flies used were apparently not infected with any trypanosome on arrival—trypanosomes not being found in either dog 174 or monkey 175, one or both of which should have shown an infection had the flies been infected.

Experiment 2.

Does *Glossina fusca* which has fed on an animal infected with *T. gambiense* become infective?

Dog 174 (for chart, vide experiment 1) collection dog.—*Glossina fusca* were fed on arrival on dog 174. Between August 24th and August 28th, 32 flies fed on this dog.

Monkey 180, "fresh-fly monkey."—Between September 1st and 18th, monkey 180 was bitten 143 times. The animal is still alive (August, 1910), and has never shown signs of trypanosomiasis.

Monkey 160, infected monkey.—This monkey was infected with *T. gambiense*. The flies surviving from monkey 180 were fed on this animal from September 21st to September 24th, the animal being bitten 33 times.

Monkey 182, "experimental monkey."—After 3 days' starvation, flies which had survived from monkey 160 were fed on monkey 182. Between September 27th and October 8th the monkey was bitten 49 times. The animal is still alive, and has never shown trypanosomes in its blood.

Conclusion.—In this case the flies used were apparently not infected with any trypanosome. Unfortunately, the last fly fed on the 18th day after the first feed on the infected monkey. The result is, therefore, inconclusive, as so few flies survived long enough for them to become infective.

Experiment 3.

Does *Glossina fusca* which has fed on an animal infected with trypanosomes from a mule become infective?

Dog 183, "collection dog."—Thirty-nine flies were fed on dog 183 between October 28th and November 12th, 1909. The dog died on January 22nd, 1910. It showed no trypanosomes in its blood during life, nor signs of trypanosomiasis post-mortem. This dog was also used to collect flies for Experiment 4.

Monkey 186, "fresh-fly monkey."—Between November 17th and December 3rd, 1909, this animal was bitten 168 times. It died on December 29th, having shown no trypanosomes in its blood during life, and showing no signs of trypanosomiasis post-mortem.

Dog 188, infected dog.—Dog 188 was inoculated with blood from dog 187 (mule trypanosomes) on November 29th, 1909. Trypanosomes were found in its blood on December 7th. Between December 7th and 9th it was bitten 34 times by flies which had survived from monkey 186. It died on December 11th.

Dog 193, experimental dog.—Dog 193 was bitten 164 times between December 14th, 1909, and January 18th, 1910, by flies surviving from dog 188. The animal died on January 19th. No trypanosomes were ever found, but the temperature chart was suspicious and the extreme emaciation of the animal was highly suggestive of a trypanosome infection. A gland puncture on January 11th, however, gave a negative result. Post-mortem there was nothing abnormal to be found.

Dog 206.—Flies surviving from dog 193 were fed on dog 206. This dog was bitten 22 times between January 21st and February 5th. The animal died on February 5th, never having shown trypanosomes in its blood. Post-mortem: nil.

Dog 205 was inoculated from dog 193 on January 18th. It died on the fourteenth day, but never showed trypanosomes in its blood. Post-mortem: nil.

Conclusion.—The results of this experiment are negative.

Although the appearance of the experimental animals was suspicious trypanosomes could never be found and sub-inoculation also gave negative results.

Experiment 4.

Does *Gl. fusca* which has fed on an animal infected with *T. gambiense* become infective?

Dog 193, collection dog (for chart, vide Experiment 3).—Between December 7th and December 18th, 1909, dog 193 was bitten 135 times. It died on January 24th, 1910, never having shown trypanosomes in its blood. Post-mortem: nil.

Dog 195, fresh-fly dog.—Dog 195 was bitten 370 times between December 21st, 1909, and January 15th, 1910, on which day it died. It never showed trypanosomes in its blood, the temperature chart did not resemble that of a trypanosome infection, and, post-mortem, no signs of trypanosomiasis could be found.

Monkey 178, infected with *T. gambiense*, was bitten by flies surviving from dog 195 44 times between January 19th and January 22nd, 1910.

Monkey 208, experimental monkey.—After four days' starvation flies surviving from monkey 176 were put to feed on monkey 208. This monkey was bitten 257 times between January 26th and March 4th, when the last fly died. The animal died on May 25th, never having shown trypanosomes in its blood, nor did it show any sign of trypanosomiasis post-mortem. The temperature chart does not look as if there had been any trypanosome infection, the temperature barely rising above 102° F. until the last week.

Enclosure in No. 6.

REPORT from the INSTITUTE FOR MEDICAL RESEARCH for the period from October 1st, 1909, to March 31st, 1910.

The researches on the etiology of beri-beri have continued to occupy the greater part of our time and attention.

The results recorded in the previous report have been confirmed and the work extended.

A brief report was issued in December and an amended copy of that report is appended. The full report is now in course of preparation, and will probably be completed about July. It may, I think, be claimed that our knowledge of the causation of this disease has been definitely advanced, since we are now in a position to explain why certain varieties of rice are associated with the occurrence of this disease and other varieties are not.

So far as this country and our immediate requirements are concerned this knowledge is sufficient and will enable us with certainty to prevent the occurrence of beri-beri.

The work is now being extended with a view to determining what the substance or substances are which are present in the sub-pericarpal layers, and which are of such vital importance for the normal metabolism of nerve tissues. Some degree of success has already attended this work, but the subject is a complex one and the search promises to be both tedious and difficult.

For the present at least the work is only of scientific interest, but should results be obtained they may shed light on the complex subject of metabolism and advance our knowledge towards the rational consideration of nutrition.

We trust, therefore, that the generous freedom of action accorded to us in the past will be continued in the future.

Routine work in pathology and bacteriology continues to increase, and every assistance is given to Medical and Veterinary Officers who refer materials for examination.

Routine work, mainly medico-legal, occupies the greater part of the time of the chemist, but he has also given assistance in the chemical part of our researches on the etiology of beri-beri.

H. FRASER,
Director, Institute for Medical Research,
Federated Malay States.

THE ETIOLOGY OF BERI-BERI.

The suggestion of a causal relationship between the consumption of white rice and the disease beri-beri was first formally made in this country by Braddon.(1) This observer also drew attention to the important fact that those who consumed rice that had been parboiled before husking remained free from the disease, as did also the native Malays who consumed rice prepared by primitive methods of pounding and winnowing.

A series of observations made by the writers(2) in 1907 on two parties of labourers, under conditions which excluded or adequately controlled the operation of factors other than diet, confirmed the correctness of this view of the causation of the disease. The prior observations of Fletcher(3) and Lucy(4) in this country, and of Dubruel(5) in Indo-China, and the recently published observations of Ellis(6) furnish further testimony, and it may now be claimed that the theory rests on a solid basis of evidence.

The mechanism by which white rice was able to produce this result has remained obscure. Braddon suggested that "the cause of the disorder is not indeed rice, *quâ* rice, or as an article of diet, but diseased rice; rice from which poison derived from decay, due perhaps to some fungus, or mould, or germ, or spore, originally, perhaps, growing upon the husk, has become mixed during the process of milling, or upon which such fungus may have grown and such poison have been produced after decortication." Eijkman(7) from experiments on fowls concluded that a definite poison exists commonly in rice, and that for this poison or its effects something in the pericarp is an antidote. Dubruel conceived the ingestion of an organism associated with white rice, which organism multiplying in the body produced the disease.

Following the line of thought suggested by the poison hypothesis, researches were undertaken to determine whether from white rices actually associated with outbreaks of beri-beri there could be extracted by means of various solvents any substance or substances recognisable by chemical methods as poisonous in character. These researches failed of their object, though it is admitted that the accuracy of the poison hypothesis was not thereby disproved.

Certain results which emerged from chemical analysis and histological examination of the rices turned attention to the possibility of an explanation of the course of events on an hypothesis of a defect of nutrition. That this explanation was inadequate, if dietary constituents as estimated by the ordinary analytical methods were alone considered, had been shown in the preliminary investigation.

By a series of experiments on domestic fowls, the details of which will be supplied in a later publication, it was shown that these animals when fed on various kinds of rice were sensitive to differences between them. The fowls were confined in separate compartments and were in all respects under identical conditions.

By further and repeated experiments with rices known to have been associated with outbreaks of beri-beri and with controls under identical conditions fed on parboiled rice, it was established that a certain reaction in fowls might be taken as an indicator of the beri-beri producing power of a given rice when forming the staple of the diet in man. Whether the disease produced in fowls be accepted or not as analogous to beri-beri in man, the validity of the arguments here advanced remains unimpaired.

Rices were available that were known to have been associated with outbreaks of beri-beri, samples having been taken daily during the continuance of the preliminary enquiry in 1907. Also, through the courtesy of Dr. J. D. Gimlette and Dr. G. D. Freer, we were enabled to procure white rice which was being consumed prior to an outbreak of beri-beri among Malays at the Kuala Lumpur Police Depot, which outbreak ceased on changing the rice supplied to the parboiled variety. It was shown that these rices when fed to fowls constantly produced a certain disease in a large proportion of them, while parboiled rice has constantly failed to produce this result in groups under identical conditions. This disease is characterised by paralysis of the legs, followed by paralysis of the wings in the more severe cases. In cases showing a moderate degree of paralysis the gait resembles very closely that seen in beri-beri. The nerves of fowls suffering from this disease show typical Wallerian degeneration.

It is our belief that this disease, *polyneuritis gallinarum*, is truly analogous to beri-beri in man, similar in its etiology, in its clinical manifestations, and we have shown them to be identical in their pathological effects, and that its occurrence should be held as important confirmatory testimony of the connection between white rice and beri-beri. It is desirable, however, to emphasise the point that the acceptance or non-acceptance of this opinion is immaterial to the argument; for this purpose the occurrence of the disease is employed only as a reaction. The fact that certain white rices when forming the staple of a diet in man produce beri-beri rests on quite other testimony than that supplied by experiments on domestic fowls.

The commercial varieties of white rice are numerous, but in this country, apart from the grading as to quality, two varieties are in common use and are known respectively as Siam and Rangoon.

From epidemiological considerations and from experimental evidence it appears that Siam rice is considerably more potent in its beri-beri producing powers than Rangoon rice.

The proteins, fats, carbohydrates, and ash were determined for the different varieties of rice which had been employed in the experiments, with the following percentage results calculated on dried material:—

—	Proteins.	Fats.	Carbohydrates.	Ash.
White rice (Siam)	9.07	0.17	90.11	0.65
White rice (Rangoon)	8.44	0.81	89.90	0.85
Parboiled rice	9.48	0.51	89.12	0.89

A comparison of these results shows that the only marked difference among the rices was in respect of fat, which was most abundant in the variety known as Rangoon, less abundant in parboiled rice, and still less abundant in Siam rice. These observations, taken in conjunction with the experimental results in fowls, excluded the possibility of an explanation of the origin of beri-beri on the ground of a deficiency in fat. It will be noted that these analyses did not include an estimation of the relative proportions of the inorganic salts composing the ash, nor did they take account of the manner of combination, organic or inorganic, in which these substances originally existed in the rice grain.

By a method devised in this laboratory, sections of the various rice grains were obtained of sufficient thinness to permit the examination in detail of their histological characters. By suitable staining methods it was shown that in parboiled rice remnants of the pericarp remained attached to the rice grain, whereas in Siam rice the pericarp and the layers subjacent to it (subpericarpal layers) had been polished away. It would appear that parboiling renders the grain tough and non-friable; in consequence, the subpericarpal layers cannot be removed so readily as in the untreated grain. It was further demonstrated that the layers so retained in parboiled rice contained the most of the aleurone and oily material present in rice grains. Rice as prepared by primitive methods (Malay rice) was similarly examined, and, as might have been expected from the pounding to which this rice had been subjected, parts of the subpericarpal layers were chipped off to a varying extent, but, on the whole, these layers were retained to a greater extent than is the case with white rice.

Early in the course of the experiments the observation was made that parboiled rice subjected to exhaustion with hot alcohol and thereafter carefully dried in the sun to free it from alcohol produced, when fed to fowls, a disease indistinguishable from that observed in fowls fed on white rice, though such parboiled rice in its original state was incapable of producing this result however long continued.

The association of the observations referred to in the two preceding paragraphs seemed to point a way to a solution of the problem. It had been shown that white rice as prepared in the mills of this country produced the same results in fowls as white rice known to have been associated with beri-beri. If now a substance or substances residing in the outer layers, which are polished away in white rice, and are retained in parboiled rice, could be added to white rice and so prevent its harmful effects, it was conceived that the nutritive hypothesis would thereby be supported.

In accordance with this idea the following experiments were initiated. A rice mill in Singapore was visited and there was obtained (A) a quantity of the grain deprived of the husk; (B) a quantity of the rice from the same lot of grain, that is, the grain from which the subpericarpal layers had been polished off; (C) a quantity of the polishings, that is, the material removed subsequent to the separation of the husk and includes the pericarp with the subpericarpal layers. The miller estimates that 40 parts of padi produces 25 parts of white rice, 5 parts of polishings, and 10 parts of husk. The polishings are sold as food for cattle and the husks are burned as fuel in the mill.

Experiment A.—Twelve fowls were fed on the husked grain for five weeks.

Result.—All remained healthy.

Experiment B.—Twelve fowls were fed on the white rice alone.

Result.—In five weeks six had developed polyneuritis; two were dead, one having suffered from polyneuritis and one from a disease other than polyneuritis; five fowls remained healthy.

Experiment C.—Twelve fowls were fed on rice taken daily from the same bag as that used in Experiment B; in addition, polishings in the form of emulsion, in amount equal to that milled from the quantity of rice consumed, were fed by a tube passed into the crop daily. This quantity was subsequently diminished week by week until only 3 grammes of polishings per kilogramme of body weight were being given daily. This amount sufficed to maintain the fowls in health and in constant weight.

Result.—The experiment was continued for seven weeks and all remained healthy.

This result was subsequently confirmed for rice from known outbreaks of beri-beri.

It will be understood that these three experiments were in progress simultaneously and that the fowls were in all respects under identical conditions.

Experiment D.—Part of the original padi was taken and milled by a Malay woman by primitive methods into the finished product as eaten by Malays. Eight fowls, fed for five weeks on the rice prepared from the original padi by the Malay method, remained healthy. Eight fowls only were used for this experiment, as the quantity of padi then remaining sufficed only for this number for the time it was estimated the experiment would last.

Attention is drawn to the important point that the products used in these experiments were all derived from the same lot of padi, and the results force us to the conclusion that it is the polishing process which is essentially at fault; the polishing of white rice removes from the seed some substance or substances essential to the maintenance of the normal metabolism of nerve tissues.

To elucidate the point as to whether rice when freshly milled is less harmful than that which has become stale, an assistant was stationed in Singapore who sent daily to the laboratory, by the most expeditious route, a quantity of rice milled on the day of despatch. Twelve fowls were fed on this rice and five developed polyneuritis in four weeks. This result, which is similar to that obtained in other experiments, when fowls were fed on rice milled from four weeks to two years previously, disposes of the suggestion that the harmfulness of white rice is due to its staleness or to the development in it of a poisonous substance or substances subsequently to its being milled. The root of the evil lies in the milling process itself. The result further indicates the inadequacy of preventive measures founded on the poison hypothesis in regard to the use of freshly milled rice.

An experiment was now planned to determine whether a parboiled rice proved harmless could, by exhaustion with hot alcohol, be reduced to such a condition that it would produce polyneuritis when fed to fowls, and whether the substances so extracted when fed to fowls with a white rice proved harmful could prevent the development of polyneuritis. For this purpose parboiled rice was repeatedly exhausted with hot alcohol. The alcoholic extracts were concentrated in vacuo at a temperature of 52° C., freed from alcohol and the residue emulsified in distilled water. Experiments with these products showed that fowls fed on the exhausted parboiled rice contracted polyneuritis, and that fowls fed on a white rice proved harmful by previous experiment remained healthy if they received in addition a quantity of the extract.

Having by these and other experiments, the details of which are omitted so as not to encumber the argument, arrived at the point when it was clear that the essential cause of beri-beri was to be sought for in a nutritive defect, further efforts were made to determine by chemical methods precise differences between various rices. Such differences, if they are to furnish an adequate explanation for the origin of beri-beri, must be in accordance with clinical observations and the experimental results in fowls.

In view of the important role played by phosphorus compounds in the metabolism of nerve tissues the amount of phosphorus in various kind of rice was determined as phosphorus pentoxide. The result of a large series of observations showed that the amount of phosphorus pentoxide obtained from rice was directly related to the probability of the rice producing beri-beri; in other words, the higher the phosphorus content of a rice the less was the liability of that rice to produce the disease, and *vice versa*.

Thus a sample of parboiled rice which was fed to fowls over many weeks, all remaining healthy, was found to contain 469 per cent. P_2O_5 , and a sample of white rice which produced polyneuritis in fowls yielded 277 per cent. P_2O_5 . The rice polishings employed in Experiment C yielded 42 per cent. P_2O_5 .

From a series of observations, it was determined that a fowl under the conditions of our experiments weighing from 1,200 to 1,400 grammes required 60 grammes of parboiled rice daily to maintain it in health and in nutritive equilibrium. In Experiment C it was determined experimentally, the chemical analysis being then unknown, that when fed on white rice a fowl of this weight required the addition of about 3.5 grammes of polishings to preserve it in nutritive equilibrium. From the data given above it may readily be calculated what amount of

polishings added to white rice is required to raise the phosphorus content of the white rice diet to that of the parboiled rice diet. Thus:—

60 grammes of parboiled rice	...	...	0.3120 grammes P_2O_5 .
60 ,, white ,,	...	...	0.1662 ,,
Difference	...	...	0.1458 ,,

Polishings contain 4.2 per cent. phosphorus pentoxide.

Calculated from the phosphorus content, therefore, 3.47 grammes of polishings added to the 60 grammes of white rice supplied to a fowl of 1,200 to 1,400 grammes weight should preserve it in nutritive equilibrium. From experimental observation, 3.5 grammes of polishings had been shown to accomplish this result. This can scarcely be regarded merely as a coincidence, but its exact significance and importance cannot yet be estimated.

Fowls receiving nothing but water do not develop polyneuritis, while fowls receiving only polished rice and water do. No satisfactory explanation of this observation has as yet been obtained, but further researches are in progress. Meanwhile the amount of phosphorus estimated as phosphorus pentoxide contained in a given rice may be used merely as an indicator of its liability or otherwise to produce beri-beri.

We are greatly indebted to Mr. B. J. Eaton, Chemist in this Institute, for valuable assistance in the chemical part of this investigation, and to Dr. R. D. Keith for suggestions as to methods for the examination of the nerves.

Summary.

1. Beri-beri is a disorder of metabolism and, as it occurs in this country, is associated with a diet in which white rice is the principal constituent.

2. White rice as produced in the mills here commonly makes default in respect of some substance or substances essential for the maintenance of the normal metabolism of nerve tissues. These substances exist in adequate amount in the original grain and in super-abundant amount in the polishings from white rice.

3. The estimation in terms of phosphorus pentoxide of the total phosphorus present in a given rice may be used as an indicator of the beri-beri producing power of such rice when forming the staple of a diet in man.

The prevention of beri-beri in this country will be achieved by substituting for the ordinary white rice a rice in which the polishing process has been omitted or carried out to a minimal extent, or by the addition to a white rice diet of articles rich in those substances in which such white rice now makes default. One such article, which is cheap and readily obtained, is the polishings from white rice.

The use of parboiled rice, as suggested by Dr. Braddon, will achieve a like result, provided that the polishing process is not carried beyond the limited extent now customary.

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No. 7.

FEDERATED MALAY STATES.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 3 December, 1910.)

MY LORD,

Government House, Penang, 9th November, 1910.

I HAVE the honour to transmit a report on the work done at the Institute for Medical Research, Kuala Lumpur, for the period from April 1st to September 30th, 1910.

I have, &c.,
JOHN ANDERSON.

Enclosure in No. 7.

SIR,

20th October, 1910.

I HAVE the honour to forward the report from the Institute for Medical Research for the period from April 1st to September 30th, 1910.

I have, &c.,
H. FRASER,
Director, Institute for Medical Research,
Federated Malay States.

The Federal Secretary,
Federated Malay States,
Kuala Lumpur.

REPORT FROM THE INSTITUTE FOR MEDICAL RESEARCH FOR THE PERIOD FROM
APRIL 1ST TO SEPTEMBER 30TH, 1910.

Beri-Beri.

As stated in the previous report, it was intended to make some observations on the practical application of the results achieved in these researches; up to the present this has proved to be impossible.

Attention has been almost wholly directed to the determination of the nature of the vitally important substance or substances present in the subpericarpal layers of the rice-grain.

This research has not been completed, but so far it has confirmed the accuracy of the work already recorded, and by a process of exclusion the problem has become appreciably less complex.

For purposes of testing the value of the various substances, fowls weighing 1,200 grms. or thereabouts were employed. Each, as in previous experiments, was confined in a separate cage, and, save in one instance, groups of twelve were used. The fowls received rice twice daily, at 10 a.m. and 3 p.m., and when receiving polishings or materials prepared from polishings the substance in question was given as an emulsion by means of a stomach-tube half an hour after the rice had been given. Every fowl was weighed once a week at 12 noon.

As the result of a series of observations, it has been determined that fowls weighing from 1,200-1,400 grms. require about 60 grms. of unpolished rice daily and, if fed on 60 grms. polished rice, they require in addition 5 grms. of sifted polishings for the maintenance of weight and health.

For purposes of comparison, the following results of analyses are given :—

—	Protein.	Fats.	Carbo- hydrates.	Ash.	Moisture.	Percentage of P ₂ O ₅ .
Polishings (sifted)	13·7	14·16	52·77	7·54	11·83	4·1
Unpolished rice	9·0	1·65	75·52	1·08	12·75	0·56
Polished rice	8·6	0·22	76·23	0·6	14·35	0·26

When the composition of these articles is calculated on dried materials the differences are rendered more striking and accurate; when in a similar manner the composition of a diet made up of 60 grms. of polished rice and 5 grms. of polishings is calculated it will be seen how closely such a diet approximates in composition to one of unpolished rice.

Calculated on dried materials :—

----	Protein.	Fats.	Carbo- hydrates.	Ash.	Percentage of P_2O_5 .
Polishings (sifted)	15.5	16.0	59.8	8.5	4.65
Unpolished rice	10.3	1.89	86.5	1.23	0.64
Polished rice	10.0	0.25	89.0	0.7	0.3
Rations, 60 grms. polished rice, plus 5 grms. polishings, contains per cent.	10.4	1.5	86.6	1.31	0.64

Sifted polishings were invariably employed because polishings as received from the millers contain a certain admixture of husk and broken rice.

Polishings when fresh are neutral in reaction; on keeping they become acid, but this does not impair their efficiency, and polishings which have been stored with ordinary care for months are quite as valuable as the fresh materials. The ordinary process of cooking does not impair the value of polishings. For these reasons it is considered that the essential substance or substances are not unstable.

Fat in the rice-grain is mostly confined to the subpericarpal layers. Unpolished rice is therefore richer in fat than polished rice, and polishings are very rich in fat.

To determine the value of this fat a quantity of sifted polishings was packed in a percolator and percolated with petroleum ether. In this way the amount of fat in the polishings was reduced from 14.16 per cent. to 0.6 per cent. The fat-free polishings were dried by exposure to the sun until free from petroleum ether.

Twelve fowls were fed on polished rice, and received in addition daily 4.5 grms. of fat-free polishings, being the approximate equivalent of 5 grms. of sifted polishings. The fowls remained healthy and maintained their weight, just as had been the case when fowls received polished rice and sifted polishings. The non-importance of fat was therefore decided, and its exclusion from the number of possibilities was of the utmost value since the fat had hitherto complicated our experiments.

The consistency with which estimations of the percentage of phosphorus pentoxide in rices had shown their value as indicators of the liability or otherwise of a given rice to produce polyneuritis was most striking. Thus, the higher the percentage of phosphorus pentoxide contained in a rice, the less liable was that rice to produce polyneuritis when fed to fowls.

Unpolished rice contains 0.56 per cent. phosphorus pentoxide, and will not cause polyneuritis. Polished rice contains 0.26 per cent. phosphorus pentoxide and invariably causes polyneuritis, while washed polished rice containing 0.21 per cent. phosphorus pentoxide is more harmful than the unwashed polished rice. This suggested the probability that the essential substance was one containing phosphorus.

It was first stated by Dr. Hans Aron, Bureau of Science, Manila, that the substance in question is phytin, the *Calcium magnesium* salt of an organic acid containing phosphorus.

We estimated that the unpolished rice in use contained 1.07 per cent. of phytin; that the polished rice contained only a trace of that salt, and that the polished rice after washing and drying contained none. The sifted polishings contain 8.8 per cent. of phytin.

In order to test the importance or otherwise of phytin, we did not employ the commercial product because of our ignorance of its source and method of preparation, but prepared it ourselves in the following manner :—Sifted polishings were mixed with 0.3 per cent. hydrochloric acid in the proportion of 300 grms. of the former to 2,000 c.c. of the latter; the mixture was stirred throughout the day, and on the following morning was filtered through a Buchner's filter. The clear yellowish filtrate was mixed with one and a half times its volume of 95 per cent. alcohol, which produced a white precipitate of phytin; the mixture was allowed to stand for a few days. The precipitate was collected, washed with strong alcohol to free it from acid, and dried in a vacuum desiccator. A friable cake of phytin was obtained readily reducible to a white powder, soluble in water, yielding an opalescent

solution with an acid reaction, and on addition of sodium carbonate a white flocculent precipitate. The powder contained 34 per cent. of phosphorus pentoxide.

A fowl consuming 60 grms. of unpolished rice daily would be receiving 0.66 grms. of phytin, and a fowl receiving the same amount of washed polished and therefore phytin-free rice would require to have in addition that amount of phytin daily in order to bring the value of this diet in respect of phytin up to that of an unpolished rice diet.

Twelve fowls were taken, and each received twice daily 30 grms of washed polished rice. Cases of polyneuritis occurred more rapidly than on the unwashed polished rice.

Twelve fowls received washed polished rice in similar quantities, and in addition phytin, which was given in the following manner:—Daily 9 grms. of phytin were dissolved in distilled water, the solution neutralized with sodium carbonate, and the volume made up to 360 c.c. Each fowl received 15 c.c. of this suspension at 10.30 a.m. and 3.30 p.m., thus receiving daily an amount of phytin slightly in excess of the estimated quantity. All the fowls lost weight, and cases of polyneuritis occurred just as if the fowls had received washed polished rice only.

In the next experiment twelve fowls received the phytin-suspension intimately mixed with the washed polished rice, but the results were the same, and the importance of phytin was by these experiments definitely disproved.

Experiments were next carried out to determine if when polishings are macerated in 0.3 per cent. hydrochloric acid the essential substance or substances pass into solution.

Polishings in quantities of 180 grms, being the amount required by twelve fowls in three days, were mixed with 1,000 c.c. of 0.3 per cent. hydrochloric acid, stirred during the day, and the following morning filtered through a Buchner's filter. 100 c.c. of 0.3 per cent. acid were used to wash out the vessels. When fluid could no longer be extracted from the mass, it was mixed with 600 c.c. of 0.3 per cent. hydrochloric acid, stirred during two hours, and thereafter filtered as before.

The extracted polishings were mixed with distilled water, nearly neutralized with sodium carbonate, and the volume adjusted to 1,080 c.c. 30 c.c. of this emulsion contained 5 grms. of polishings, less the materials dissolved out by the acidulated water.

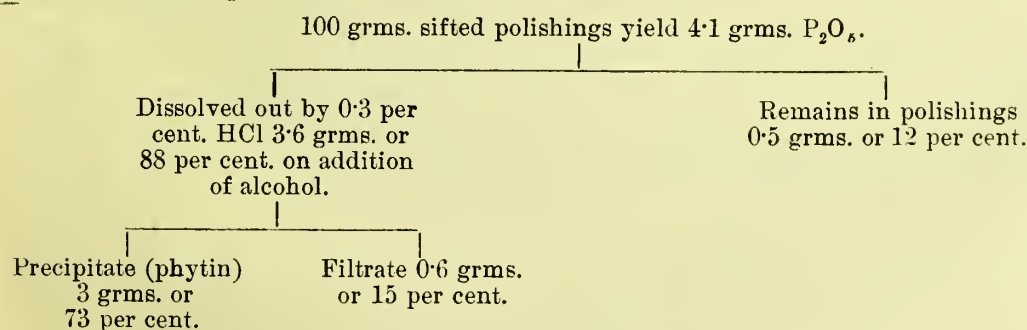
The combined filtrates obtained from 180 grms. of polishings were nearly neutralized with sodium carbonate and concentrated at a low temperature to a volume of 1,080 c.c. 30 c.c. of this suspension contained the substances solved out by acidulated water from 5 grms. of polishings.

Twelve fowls were taken and fed on washed polished rice, each receiving daily 30 c.c. of the emulsion of extracted polishings; cases of polyneuritis occurred.

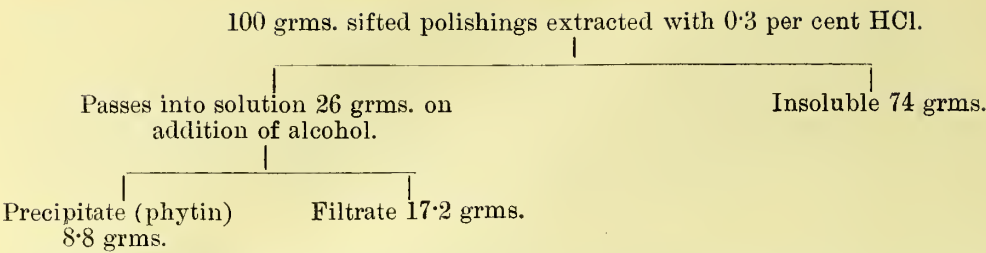
Twelve fowls were taken and fed on washed polished rice, each receiving in addition 30 c.c. of the suspension of dissolved substances; cases of polyneuritis did not occur.

Therefore the essential material was removed and uninjured by the process of extraction and subsequent treatment.

By this process of extraction 88 per cent. of the phosphorus pentoxide contained in polishings is dissolved out. Of that 88 per cent., 73 is represented by the phytin in the solution, so that, together with the 12 per cent. remaining in the polishings after extraction, 85 per cent of the phosphorus pentoxide contained in polishings is shown to be unimportant.



When polishings are extracted in the manner described 26 per cent. passes into solution and 8.8 of that amount is precipitated by the alcohol. Therefore in the alcoholic filtrate containing 17.2 of the soluble substances obtained from polishings, must be contained the essential material.



Experiments were next carried out to verify the accuracy of this observation. Polishings in quantities of 180 grms. were treated as in the previous experiment, the combined filtrates from each 180 grms. being mixed with one and a half times their volume of 95 per cent. alcohol. After standing for two days the precipitate was filtered off and dissolved in warm distilled water, nearly neutralized with sodium carbonate and the volume adjusted to 1,080 c.c. 30 c.c. of this suspension contained the phytin from 5 grms of polishings.

Six fowls were fed on washed polished rice, and received daily 30 c.c. of this suspension of phytin; cases of polyneuritis occurred, thus confirming the accuracy of the previously recorded experiments which proved the unimportance of phytin.

The alcoholic filtrate was nearly neutralized with sodium carbonate, and evaporated at a low temperature until free from alcohol. The residue was diluted with distilled water to a volume of 1,080 c.c. 30 c.c. of this suspension contained the almost phytin-free soluble substances from 5 grms. of polishings.

Six fowls were fed on washed polished rice, and each received daily 30 c.c. of this suspension; all remained healthy.

These experiments prove that of 5 grms. of sifted polishings required daily for the maintenance of weight and health in a fowl, no less than 4.2 grms, are unimportant, and of the 0.8 gm. remaining probably only a part is essential.

Arrangements are now in progress for the repetition of this important experiment on a larger scale. The attached table will, I hope, make clearer the point at which we have arrived.

Routine and other work.

Under this heading is comprised the large and varied assortment of materials submitted for investigation and report by medical officers and others.

A considerable number of malignant tumours were examined.

Materials collected and received from cases of cholera furnished some interesting results.

Some valuable additions were made to our collection of parasites of man and the lower animals.

In the chemical department it has not been possible to carry out the work in a satisfactory manner.

H. FRASER,
Director, Institute for Medical Research,
Federated Malay States

	Effect on fowls; estimated by the occurrence of polyneuritis.	Estimated percentage of fat in diet.	Estimated percentage of P ₂ O ₅ diet.
Unpolished rice	—	1.65	0.56
Polished rice plus polishings	—	1.3	0.55
Polished rice	+	0.22	0.26
Washed polished rice	+	0.22	0.21
Washed polished rice plus fat-free polishings	—	0.25	0.51
Washed polished rice plus polishings	—	1.3	0.51
Polishings extracted with 0.3 per cent HCl.			
Washed polished rice plus extracted polishings	+	1.3	0.23
Washed polished rice plus extract	—	0.22	0.47
Extract mixed with one-and-a-half times its volume of 95 per cent. alcohol.			
Washed polished rice plus precipitate (phytin)	+	0.22	0.41
Washed polished rice plus filtrate	—	0.22	0.24

No. 8.

REPORT BY DR. H. CAMPBELL HIGHET, MEDICAL OFFICER OF HEALTH, BANGKOK, ON THE WORK OF THE LOCAL SANITARY DEPARTMENT FOR THE YEAR 1ST APRIL, 1908, TO 31ST MARCH, 1909.

BERI BERI.

(Extract.)

The following upon Beri Beri has already been presented as a Special Report.

Memorandum on Beri Beri in Siam.

Beri beri is a disease which is found in tropical and sub-tropical countries. It is a disease of the nerves, but whereas many nervous diseases are located in the brain and spinal cord—the central nervous system—this disease affects the peripheral nerves—the nerves of the trunk of the body and limbs.

The symptoms of the disease:—

As one so often sees, the first symptoms are often referred to the stomach. There is a sense of discomfort at the pit of the stomach—"nen na ok" as a Siamese would say. Breathlessness and heart palpitation on exertion are complained of, and soon pains in the limbs with a sense of weakness and a loss of sensibility, "nep cha," begin to show themselves. The muscles of the calves may be found to be swollen and tender to the touch, and soon slight dropsy of the feet or shins will be found.

The disease may now develop into dry or wet beri beri.

In *dry beri beri*, the initial slight dropsy may disappear, and the weakness of the limbs develops into actual paralysis so that the patient may be unable to walk or to move his arms. The muscles—perhaps swollen at the first—now waste away—and in this condition the patient remains either until he dies or until recovery begins.

If the case develops into one of *wet beri beri*, dropsy is the most marked feature. This dropsy may be so great that the whole system becomes water-logged, and the patient may die from obstruction to the action of the heart and lungs caused by the presence of the fluid.

Palpitation, rapid action of the heart, and breathlessness are common symptoms of this form of the disease.

A third variety may be described as the *acute or heart form of beri beri*. The patient has probably suffered from the dry form for some time when for some reason or another—it may be extra exertion or hardship—the heart begins to fail and death may occur within twenty-four hours. Quite a large number of such cases have been admitted into the Police Hospital, and so rapidly has death taken place that many corpses have been sent to the mortuary on suspicion of foul play being the cause of death.

The mortality from beri beri varies greatly, but may be anything from 2 to 50 per cent. The disease tends to appear in an epidemic form, and in every epidemic the mortality may be greater or less.

The cause of beri beri is a subject upon which many varied opinions have been expressed.

That it is due to a living germ has been advocated by many, especially by the Dutch physicians, and it was even held to be contagious.

More stress has been laid upon the idea that it is a food disease, some believing that it is due to eating bad rice, others to eating certain kinds of fish. That food has much to do with the causation of beri beri is proven by the results of the change of diet in the Japanese Navy. In this service, the disease was a scourge until the diet was improved, when it practically died out.

In Java, in the prisons, it was found that the proportion of cases was 1 to 39 when the rice was eaten completely shelled—white rice—but only 1 in 10,000 when the grain was eaten with its skin or pericarp. Again, it has been stated that steam milled rice gives rise to beri beri, whereas hand milled rice does not. This is not our experience, however, in Siam. I have seen many cases of beri beri develop amongst people eating only hand-milled rice, and during the recent examination of conscripts for the Bangkok Police, a very large percentage of recruits were refused because of beri beri, and yet the men had lived all their lives more or less on hand-milled rice.

Such, then, was the uncertainty as to the cause of beri beri until Doctor Bradon, the Residency Surgeon in Negri Sembilan, Federated Malay States, took up

the question. He showed that amongst the immigrant peoples of the Malay Peninsula, the Chinese suffer severely while only a few cases are ever seen amongst the Tamils. He believes that the disease is due to the consumption of stale white rice such as is eaten by the Chinese coolies, and that the reason for the exemption from the disease amongst Tamils is that they only eat parboiled rice. The Malays are immune, according to Braddon, because they only eat rice prepared from padi newly husked. Here is no doubt the reason why hand-milled rice is said not to cause beri beri. It only enough to last a few days is milled at a time, it remains fresh, but if a large quantity is prepared, it soon deteriorates in the native dwellings, and may then give rise to beri beri.

Braddon believes that beri beri is due to a special fungus which probably grows upon the surface of the rice grains.

When white rice is prepared by machinery, no preliminary treatment is given to the padi, and so the fungus is apparently not entirely removed. When this rice becomes stale, it is said to produce beri beri if eaten for a certain length of time.

Parboiled rice, as eaten by the Tamils, is prepared in the following manner:—

The padi is placed in large tanks, and is there soaked in water for 24 to 48 hours. The water is then run off, and the padi is put into a lightly-covered vessel and steam is passed through it for from five to ten minutes. It is then removed from the steamer and is spread out to dry, either in the sun or in a room in which hot dry air is made to circulate. When dry, the padi thus prepared may be milled at once or it may be stored until required without deteriorating in quality as is the case with white rice.

Now Braddon's theory is that people fed on this rice do not develop beri beri, whereas those fed on stale white rice are apt to suffer from the disease sooner or later. As the question is one of great economic importance in the Straits Settlements and the Federated Malay States, owing to the great amount of sickness and the high death-rate amongst the labouring population, the British Government appointed Doctors Fraser and Stanton, of the Institute for Medical Research, Kuala Lumpur, to investigate the matter. In a preliminary report entitled "An enquiry concerning the Etiology of Beri Beri," these two medical men describe in detail a very interesting series of experiments.

"The general results tend to support the view that the disease beri beri as it occurs in this Peninsula has, if not its origin in, at least an intimate relationship with, the consumption of white rice and justify further research along these lines."

On the 12th February of this year, I commenced the use of parboiled rice in the asylum for the insane—a hot-bed of beri beri—and the results have been so remarkably successful that I determined to prepare this memorandum in order to lay the matter before the Government, with the hope that parboiled rice will be employed and beri beri done away with, in the Services at least.

Before describing my own experiments, it might be well if something were said with regard to the history of beri beri in Siam and to give such data as I can obtain in order to show the grave nature of the disease as a cause of invaliding and death.

Early records are impossible to obtain, but it is quite evident that the disease has been present in the country for many years.

Doctor Chr. Rasch, who was in Bangkok during 1891 and 1892, states in an article on "The Climate and the Diseases of Siam," published in Virchow's Archives, 1894, that: "As in the Malay Archipelago, so in Siam, beri beri is fairly common especially in that class of the population living under bad hygienic conditions. In the new State jail, built on European lines, and kept clean and decent, beri beri is comparatively infrequent."

In 1892, however, Doctor T. Heyward Hays, who was then associated with the late Doctor Willis in the medical charge of the jail, had to do with rather a severe epidemic of beri beri in this jail.

Dr. Scheube, who was in Siam about 1892, apparently made a careful study of the diseases prevalent in the country. In his book on "The Diseases of Warm Countries" he states that "the disease is frequent in Burmah and Siam."

Subsequent to the date of these observations, the disease seems to have remained in abeyance for a number of years. When I arrived in Siam in April, 1897, I was struck with the absence of beri beri from amongst the ordinary indigenous diseases. This was not only the experience of my predecessor, Doctor Nightingale, who had been in Siam since 1893, but also Doctor Deuntzer, who had been in private practice for many years in Bangkok, informed me that beri beri was a rarity here.

Although both Doctor Nightingale and I had seen much of this disease in Johore and Singapore respectively before coming to Siam, and although we had ample opportunities of seeing all sorts of diseases amongst rich and poor, the first case of beri beri noted by us was that of a Siamese police constable who was admitted to the Police Hospital on the 29th August, 1900. Another case came into hospital a month later, and after that no further cases are noted in the hospital register until April, 1901, since when beri beri has become one of the ordinary diseases seen in the hospital. During this year, 1901, a very severe epidemic broke out amongst the soldiers in the central barracks, two cases were reported from the navy, cases began to appear in the general hospitals other than the Police Hospital where 24 cases were recorded during the year. In an appendix* I have given a return of cases of, and deaths from, beri beri recorded in the hospitals, the navy, the army, and the police during the past eight years.

The following are the totals for the eight years in question:—

Year.						Cases.	Deaths.	
120	...	...	...	...	...	1,128	...	14
121	...	...	...	...	...	1,007	...	81
122	...	...	...	...	...	2,615	...	161
123	...	...	...	...	...	2,813	...	103
124	...	...	...	...	...	3,361	...	92
125	...	...	...	...	...	2,712	...	101
126	...	...	...	...	...	4,427	...	229
127	...	...	...	...	...	4,607	...	282
Total						22,670	...	1,063

We see from these figures that this disease has been steadily on the increase, and if it had been possible to have obtained the figures for the ordinary civil population, the total would be much more striking. It has been impossible to accurately calculate the death-rate as so many cases were lost sight of by being sent home.

The bare figures themselves, however, give no idea of the grave inconvenience which has so often been caused by so much invaliding in the Services. This was specially brought to my notice in the case of the first batch of conscripts for the Bangkok police. Called up early in December they were temporarily housed in the Ministry of Local Government as the new police school was not ready for occupation. Cases of beri beri began to develop on the 30th December, and on the 10th January the men were transferred to the buildings formerly occupied by the Sericulture Department.

Beri beri did not cease but rapidly increased to such an extent that on the 7th February, out of an original total of some 400 men only 227 remained. Of these 180 were found to be suffering from the initial symptoms of beri beri, and were sent home on a month's leave as had been all the previous cases. The remaining 47 men free from disease were drafted to police stations, and the school was temporarily closed.

Everything was done in the way of change of food and attention to hygiene, but no difference was made in the daily average of men who reported themselves sick. I then determined to make a trial of parboiled rice although Doctors Fraser and Stanton's report had not then been published. Dr. D. K. McDowell, Principal Civil Medical Officer, Straits Settlements, was kind enough to furnish me with a full description of preparing the rice. For various reasons the asylum for the insane was chosen as the site for the original experiment. Here we had a notorious hot-bed for beri beri, we could control the dietary in every way, and we could easily observe the results of the new diet from day to day. Khoon Adul, the resident doctor, was initiated into the mysteries of the preparation of parboiled rice, the necessary apparatus—all of a very simple nature—was purchased, and a number of the able-bodied patients were told off to carry out the work. By the 12th February, a sufficient quantity of the new rice had been prepared, and was on that day first issued to the patients. As there was still a considerable amount of white steam-milled rice in store, one form was given in the morning and the other in the evening. By the end of February only parboiled rice was used.

Notwithstanding this partial dieting at the commencement, the results were

* Not reprinted.

immediate, and, indeed, marvellous. During a period of twenty years' medical practice I can truly say that I have never seen anything more striking.

There were then some 22 insane patients suffering from beri beri. Of these only four have since died. *No new case of beri beri has arisen since parboiled rice was first issued.* All the old patients have steadily improved, and all express themselves as feeling much better since they started to eat red rice, or "kau deng" as they call it. It would seem that this rice is not only a preventive, but actually a curative agent. This was especially noted in the case of several well-marked cases of "wet" or dropsical beri beri. One woman I remember distinctly was, in my opinion, in a very dangerous condition. She was so swollen as to be practically water-logged, and yet in a fortnight all dropsy had completely disappeared, and her appearance was quite natural.

No other change in any way whatever has been made in the dietetic or hygienic conditions under which these patients live.

As soon as enough parboiled rice could be prepared for use in other institutions, it was supplied to the Hospital for Infectious Diseases, to the police prisoners, and to the Reformatory at Koh Si Chang. The same results have followed its use in these institutions.

It must be evident that these experiments have totally changed our outlook upon the disease, and our methods of dealing with persons suffering from it.

Hitherto partly labouring under the idea that it was contagious either through personal contact or because a patient infected his surroundings in some way or other, and partly believing that change of residence was curative, we have been in the habit of at once sending away to his own home any constable who was found to be suffering from the disease.

There is no doubt that such men often came back at the expiry of a month very much improved, but, on the other hand, many took months to recover, while many had to be invalided out of the force.

Now we put such a patient on a course of parboiled rice, and find that recovery is rapid and is permanent provided he continues to eat only this form of rice. That people are beginning to understand this is shown by the passage in the report on the Hospital for Infectious Diseases where Dr. Carthew reports that sufferers from beri beri are clamouring for admission to the hospital in order to obtain the benefits which their friends have derived.

A word in conclusion may be said with regard to the rice in question. It has a darker appearance than white steam-milled rice, hence the name red rice applied to it. It has rather a mouldy flavour, and for the first few days it seems to be more difficult of digestion. This difficulty soon disappears, and most of its consumers say that it is an excellent laxative. The sense of stomach discomfort so generally felt by beri beri patients is one of the first symptoms to disappear, and a general feeling of well-being early develops.

As the grains are rendered very hard, owing to the method of preparation, care should be taken to cook the rice longer than ordinary white rice.

Conclusions.—It will be seen from the foregoing:—

(1.) That the results of our experiments in Siam tally with those in the Straits Settlements and the Federated Malay States; and

(2.) That until the real cause of beri beri has been discovered, the disease can be prevented and actually cured in the majority of cases by the substitution of parboiled rice for white rice. It is, therefore, imperative upon all those who are responsible for the health of individuals in the Services or in such institutions as hospitals, asylums, or schools, to note that they have at hand an easy method of preventing the disease, and that the responsibility for an outbreak should be laid upon them in a most emphatic manner.

In the covering letter submitted to Your Excellency along with the above memorandum, the following points were specially noted:—

(1.) During that period we have records of practically 22,670 cases of the disease.

With the exception of 2,099 cases seen in the hospitals, the cases reported are all young male adults. Beyond the hospital cases I have no other records of beri beri in the civilian population male and female.

(2.) Beri beri is usually rather a chronic disease extending over one, two, or more months, but if we, to be on the safe side, calculate that each of the above 22,670 cases was ill and off duty for one month only, we yet have an enormous loss of efficiency in the various Services during these eight years.

(3.) The financial loss to the Government, however, is even more striking. I calculate that on an average, every case has cost the Government Ticals 20. This gives a total loss of Ticals 453,400, or an average of Ticals 56,676 per annum for eight years.

(4.) The death-rate reported is no index of the total deaths from this disease, as owing to the absence of registration of deaths in Siam, it is impossible to know the mortality from any disease. As I have stated in the memorandum, the death-rate from beri beri may be anything from 2 to 50 per cent. Our figures give a rate of 4·6 per cent., but in my opinion this is far below the actual figures. The hospital returns give a general death-rate of 26 per cent. during these eight years. In the lunatic asylum during the year 125, the death-rate was 83·7 per cent., during the year 126, 78 per cent., and during 127, 88 per cent., where the conditions were remarkably unfavourable for recovery, however. But even to take the average death-rate at 10 per cent., we get a death-rate of 2,267 young male adults from this disease alone in eight years, an enormous economic loss to the country.

(5.) As I have already demonstrated in practice in the asylum, police school, and reformatory at Koh Si Chang that the disease can be prevented by the use of parboiled rice, it is evident that by this simple means, which entails practically no more expense on the Government, a financial saving of Ticals 56,676 per annum is possible, and a high death-rate can be avoided.

No. 9.

HONG KONG.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 5 September, 1910.)

MY LORD,

Government House, Hong Kong, 4th August, 1910.

I HAVE the honour to forward the enclosed copy of a letter from the Government Bacteriologist, dated the 28th ultimo.

2. In the penultimate paragraph of his letter Dr. Macfarlane refers to the matter which formed the subject of your Lordship's despatch of the 14th August, 1908,* and previous correspondence.

I have, &c.,

F. H. MAY,

Officer Administering the Government.

Enclosure in No. 9.

SIR,

Bacteriological Institute, Hong Kong, 28th July, 1910.

FLEET-SURGEON SHAW, R.N., acted as Bacteriologist from January 1st to April 13th. As he was only able to give part of his time to the work, I understand he has no research work for that period which he wishes to be published.

I took over the institute and the public mortuary on April the 14th, and during the following two and a half months have been fully occupied with:—

- (1) Reorganisation of the laboratory which appeared to be necessary owing to the frequent changes of hands it has passed through recently.
- (2) Routine work which has more than doubled.

Very little time was left for any research work, but a start has been made to collect and classify as far as practical the more important flies, especially biting flies, ticks, fleas, &c., of Hong Kong. It is hoped that arrangements will be made by which the specific determination of suitable collections of flies, &c., will be done at home, and that a named collection will be made and kept in the institute.

The investigation of the life history of *Opisthorcis sinensis*, which has apparently engaged the attention of my two predecessors here, will be continued, using chiefly the Hong Kong cats, as they are apparently largely infected.

I have, &c.,

HAROLD MACFARLANE,

Bacteriologist.

To the Hon. Principal Civil Medical Officer.

AUSTRALIA.

REPORT BY DR. BREINL, DIRECTOR OF THE AUSTRALIAN INSTITUTE OF TROPICAL MEDICINE, TOWNSVILLE, ON THE RESULTS OF HIS JOURNEY TO THE NORTHERN PORTS OF QUEENSLAND, DATED JULY, 1910.

Presented to the Parliament of the Commonwealth by Command, 8th September; ordered to be printed, 20th September, 1910.

I beg to report in brief on the results of my journey to the northern ports of Queensland. I left Townsville on 14th May, with the intention of visiting the coastal towns north of Townsville up to Thursday Island, in order to come in personal contact with the profession, and to secure an ample supply of material in the form of interesting cases, blood slides of patients suffering from obscure fevers, &c., for the institution in Townsville.

I stayed for one week in Thursday Island. I was informed that it was just then the healthiest time of the year, and that since the beginning of January bad epidemics of dysentery and dengue had been prevalent.

In the hospital wards I saw a good many cases of beri beri, the disease affecting mostly coloured races. It would, in my opinion, be well to make the question of beri beri the object of special study. A number of cases shown to me had only slight symptoms of typical beri beri, pain in the region of the duodenum and a more or less pronounced neuritis affecting the nerves of the legs. Other cases, however, proved to be fully developed beri beri. I have seen it in South America, heart symptoms being the most striking characteristic symptom. The former cases, however, did not show any heart symptoms at all, and have, therefore, to be regarded as beri beri of a specially mild type, or possibly as cases being due to different etiology. The patients in question are, as Dr. White, the Superintendent of the Hospital, informed me, to a great extent incapacitated from work, as many of them, after having improved, leave the hospital, and come back regularly once or twice a year for treatment.

I had the opportunity to examine a few cases of filariasis amongst New Guinea natives; furthermore, skin diseases of different kinds, which seem to offer a good opportunity for original investigation.

Bishop White, of Thursday Island, invited me to join him on a trip to one of the mission stations, Moa, a small island about 30 miles north of Thursday Island. Whilst there I had an opportunity of examining a few cases of malaria, of syphilis, and to see one case of typical yaws.

On inquiring, Bishop White informed me of the fact that there was a good deal of sickness amongst the natives on the different islands, and also on the mainland, around the Gulf of Carpentaria. I am convinced that, should I be able to visit the different islands with a moderate laboratory outfit, on a reliable boat, a good deal of material for scientific study could be obtained.

Owing to the fact that I missed the connecting boat for the south in Cooktown by one hour and a half, I was detained there for one week.

Dr. Kortum, in charge of the hospital, brought some cases of imported malaria from New Guinea to my notice. My attempts to come in contact with the aborigines in Cooktown failed, owing to the shy and timid nature of the aborigines living on the native reserve close to Cooktown.

One week spent in Cairns convinced me that there was plenty and varied material at this town offering good opportunities for original and economically useful work. Dr. Knowles, Dr. Baxter-Tyrie, and Dr. Kerwin, were exceedingly kind, and did all in their power during my short stay to give me an opportunity to get a real impression of the conditions which exist at Cairns.

One of the diseases in Cairns most prevalent and most important from an economic point of view is ankylostomiasis.

Dr. Kerwin showed me one street, Sandy Gallows, in which in nearly every house cases of ankylostomiasis could be found. I selected one house at random, and in nearly every specimen of faecal matter I examined microscopically the typical eggs were found. Dr. Knowles, in charge of the hospital, informed me that a considerable number of children came up weekly to the hospital for the treatment of ankylostomiasis.

Cairns is low-lying, built on sandy soil, having a humid and hot atmosphere, and affords a splendid breeding ground for ankylostoma embryos. I am convinced that ankylostomiasis is more prevalent at Cairns than is at present realized; and I believe that many cases in adults would be found if sought for.

It is a well-proved and accepted fact that ankylostomiasis in the white man is a disease of consequence and of economic importance.

It can, in all probability, be proved that this disease is instrumental in bringing about a deterioration of the affected individual in many respects. And especially if children are affected during a time when the brain is most active and open to impressions, disease is bound to have a permanent blighting influence on the mental and even moral development of these children.

It would, therefore, appear most desirable to make a careful and thorough investigation in Cairns as to the distribution and prevalence of ankylostomiasis amongst the inhabitants, and especially amongst school children, and at the same time to collect evidence as to the extent to which this disease interferes with the bodily and mental development of children; and last, but not least, offer suggestions for the eradication of this disease.

The work in connexion with an ankylostomiasis campaign would naturally require a stay of some months in Cairns. The local doctors with whom I talked over my ideas gave me promises of their heartiest support and help in case I should be able to undertake this, to my mind, important work.

During my stay at Cairns I had the opportunity of seeing a few cases of the so-called "sandworm" disease, a peculiar kind of inflammation of the skin occurring on the inner side of the foot. As far as I could ascertain, the etiology and pathology of this complaint is not at present clearly understood. According to one opinion, the lesion is due to a variety of earth worm entering the skin; others regard it as the place of entrance of the ankylostoma duodenal.

Dr. Knowles, for instance, took me to one house to which a family had moved only a short while ago, and the mother and two children all contracted this sandworm disease within a short time of their stay.

I examined one case carefully, dissecting, as far as possible, into the flesh, but could not find any trace of a "worm." Only careful and experimental research will, in all probability, give a clue to the etiology of this complaint. I saw, with Dr. Baxter-Tyrie, a few cases of fever of a nondescript type differing from dengue, as no rash could be observed, and the cases occurred only sporadically in different parts of the town; the cases could not be regarded as influenza, as no chest symptoms were apparent.

I took the opportunity to make a few blood smears, and examined those carefully after my return to Townsville, without, however, finding any evidence of a definite parasite.

Dr. Knowles showed me, at the hospital, a few fever charts of recent date, the fever being of an irregular, typical-like type.

Samples of blood sent to Brisbane were found negative with regard to Widal's Reaction. Cases of the latter type also seem to offer a good opportunity for a thorough investigation.

During my short stay at Geraldton I saw one case, and heard of more, which go under the diagnosis of typho malaria. The diagnosis, according to the present state of our knowledge, is vague and indefinite. It would certainly seem advisable to investigate cases of this description, and determine whether a complex of symptoms as typho malaria could be caused by malaria parasites, or whether these cases have some other etiology.

On inquiring, I was informed that it would be exceedingly difficult to get the patients, who are mostly cane-cutters, to consent to come to the Townsville hospital for investigation and treatment, as they are unwilling to spend more time than is absolutely necessary on sick leave during the cane-cutting season.

Dr. Clarke, the Resident Surgeon of the Port Douglas Hospital and Physician to the Mossman District, mentioned in conversation that a special fever occurred in the Mossman district, a fever which usually begins with an acute onset, and gives rise to lymphadenitis in the form of swelling of the lymph glands. This fever often attacks new-comers, even after a short stay in the district (about three months), and is commonly attributed to "filaria." This fever also seems to call for thorough investigation.

During my stay in Townsville, and during my journey north, the question of the work of cane-cutting was repeatedly brought to my notice. Is the white man able

to stand the strain of cutting cane in the tropical parts of North Queensland without having his health permanently injured?

The consideration, and, if possible, the solution of this question, seems to be of vital importance for the development of the sugar industry in North Queensland, and would also throw some light upon the White Australia question generally. In my personal opinion, alcoholism and other debilitating habits do much more than cane-cutting to impair the health of the workers. It would, however, be possible, and perhaps advisable, to study this question from a statistical standpoint.

On inquiring I ascertained that, according to the conditions of work, it would not be possible to throw light upon this question by basing the conclusions upon a fairly large mass of material which should be available.

The cane cutters usually work in gangs under a "boss" during a season. One could, therefore, examine a number of them from a general point of view with regard to blood and general condition at the beginning and at the end of the cane-cutting season, and come to a definite conclusion as to the effect of this particular kind of work upon Europeans. There may be a possibility of extending this work over more than one season, and which fact would add to the value of the results.

It seems to me that all the problems referred to in this short report would, if worked out from a scientific point of view, soon prove the necessity of the Institute, and would also, which is of great importance, arouse the interest of the public in the Institute, and thus secure for it more general and liberal support, and thereby enable its operations and usefulness to be extended.

I may point out, further, that a good deal of purely scientific work can be done in Townsville when the preliminary difficulties as to an ample and continuous supply of experimental animals, &c., have been overcome.

I am convinced that the teaching aids of the Institute also can be developed, especially should I succeed in attracting patients to the Townsville hospital for treatment, and to act at the same time as material for teaching purposes.

As far as I have seen, there is an ample material of parasites in the lower animals, in the shape of protozoa and intestinal parasites, which, if worked out on the proper lines, will not only yield results interesting from a scientific point of view, but also from a practical standpoint, by affording an insight and clue to the closer understanding of hitherto obscure parasites of economic importance.

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